



The Buffalo Hump Site

Late Prehistoric Occupation
in the Great Divide Basin,
Wyoming



By Lynn L. Harrell

Bureau of Land Management
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THE BUFFALO HUMP SITE:
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by
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with Appendices by
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FOREWORD

The Buffalo Hump site is a multicomponent prehistoric habitation camp that was excavated by Archaeological Services of Western Wyoming College during 1985 and 1986. Data Recovery was designed to mitigate adverse effects from construction of Exxon's Bairoil/Dakota CO₂ Pipeline, Section One, from Green River to Jeffrey City, Wyoming. A total of 318 square meters was excavated, producing evidence of four occupations spanning the last 2000 years. A revealing analysis of patterns of settlement and subsistence during the past 2000 years in the Great Divide Basin of Wyoming testifies to a strict adherence to principles of archaeological investigation and for getting maximum return for data collected. When such rigor is used in conjunction with the excavation of large activity and associated areas (as in the Buffalo Hump project), the nature and extent of behavioral information obtained is impressive.

It is with pleasure that we present this volume, the seventh in the Bureau of Land Management's ongoing cultural resource monograph series. We believe the publication will prove to be a valuable addition to the library of the professional and amateur archaeologist alike, as well as an important contribution to the discipline of archaeology.

Raymond C. Leicht, Ph.D.
Series Editor
Bureau of Land Management
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Table of Contents

	<u>Page</u>
Foreword	ii
Acknowledgements	iii
Table of Contents.	iv
List of Figures	vi
List of Tables	ix
 Chapter 1 - Introduction	 1.1
Project Background	1.2
Research Orientation	1.4
Component/Activity Area Analysis	1.5
Regional Research Questions.	1.5
 Chapter 2 - Background Information	 2.1
Environment.	2.2
Site Setting	2.2
Physiography	2.2
Climate.	2.6
Vegetation	2.6
Animals.	2.8
Cultural History of the Region	2.9
Paleoindian Period	2.9
Archaic Period	2.11
Late Prehistoric Period.	2.11
Previous Investigations at the Buffalo Hump Site	2.11
 Chapter 3 - Methodology	 3.1
Field Methods.	3.2
Implementation Strategy.	3.2
Basic Techniques of Excavation and Documentation	3.6
Basic Laboratory Analysis.	3.9
Cataloging and Curation Procedures	3.10
Artifact Analysis.	3.10
Feature Analysis	3.16
Faunal Analysis	3.16
Pollen and Macrofloral Analysis.	3.17
Sediment Analysis.	3.18
Component/Activity Area Analysis	3.18
 Chapter 4 - Results.	 4.1
Stratigraphy	4.2
Component Definition	4.5
Component 1.	4.7
Component 2.	4.14
Component 3.	4.36
Component 4.	4.57

	<u>Page</u>
Chapter 5 - Interpretations	5.1
Contributions to Research Themes	5.2
Site-specific Interpretations.	5.2
Regional Research Themes	5.26
Summary.	5.32
Chapter 6 - Management Summary	6.1
Project Summary.	6.2
Recommendations.	6.3
References Cited	R.1
Appendices	
Appendix A: Feature Analysis by Lynn L. Harrell	
Appendix B: Artifact Analysis by Michael Bergstrom, Lynn L. Harrell, and Scott T. McKern	
Appendix C: Faunal Analysis by Michael Bergstrom	
Appendix D: Plant Macrofossil Analysis by Craig S. Smith	
Appendix E: Pollen Analysis by Linda J. Scott	
Appendix F: Sedimentology, Stratigraphy, and Climatic Interpretations by J. C. Miller	

List of Figures

<u>Figure</u>		<u>Page</u>
1	State of Wyoming map showing the location of the Buffalo Hump site	1.3
2	Topographic setting of the Buffalo Hump site	2.3
3	Contour map of the Buffalo Hump site.	2.4
4	View of the site showing the area of investigations before the start of excavations	2.5
5	Illustrates the cultural chronology for southwest Wyoming proposed by Zier et al. (1983) compared to the scheme for the Northwest Plains (Frison 1978) . .	2.10
6	Map of the pipeline corridor through the site	3.3
7	Map showing the locations and sizes of all block excavations conducted in 1985 and 1986 at the site. .	3.4
8	View looking grid northwest of the 1985 excavations, showing how tents were used to protect excavations from snow	3.4
9	View looking grid northwest of the 1985 excavations	3.8
10	Illustration of measurements taken from projectile points.	3.12
11	Illustration of idealized reduction sequence for bifaces and flake tools	3.13
12	Representative profile of the west wall of the 1986 excavation block showing the stratigraphy typical of the entire block area	4.3
13	Illustration of the units from which the four cultural components were documented in the excavation at the site	4.8
14	Postexcavation photograph of Feature 4	4.9
15	Plan map of the main excavation block showing the locations and types of all cultural remains recovered from Component 1.	4.11
16	Plan map of the main excavation block showing the three activity areas, the locations, and types of cultural remains recovered from Component 2	4.15

<u>Figure</u>		<u>Page</u>
17	Graphic illustration of the plan view and cross section of a pit structure from Activity Area A in Component 2	4.17
18	Postexcavation photograph of a pit structure from Activity Area A in Component 2.	4.18
19	Postexcavation photograph of a large, oxidized, bell-shaped pit from Activity Area A located on the southern edge of a pit structure, Component 2	4.19
20	Postexcavation photograph of a large, oxidized, bell-shaped pit, located in the center of a pit structure in Activity Area A, Component 2.	4.19
21	Pre-excavation photograph of the exposed upper outlines of four features from Activity Area A in Component 2.	4.20
22	Graphic illustration of the plan view and cross section of a pit structure from Activity Area B in Component 2	4.21
23	Postexcavation photograph of a pit structure from Activity Area B in Component 2.	4.22
24	All flaked lithic tools recovered from Component 2.	4.25
25	Modified bone artifacts recovered from Component 2.	4.29
26	Enlarged illustration of the juniper seed bead recovered from Component 2	4.31
27	Plan map of the main excavation block showing the three activity areas, the location, and types of cultural remains recovered from Component 3.	4.37
28	Graphic illustration of plan view and cross section of a pit structure from Activity Area A in Component 3.	4.38
29	Postexcavation photograph of a pit structure from Activity Area A in Component 3	4.39
30	Postexcavation photograph of a large, oxidized, bell-shaped pit located in a pit structure from Activity Area A in Component 3	4.41
31	Graphic illustration of plan view and cross section of Feature 17 from Activity Area A in Component 3.	4.41

<u>Figure</u>		<u>Page</u>
32	Postexcavation photograph of three adjacent features from Activity Area B in Component 3	4.42
33	Postexcavation photograph of three adjacent features from Activity Area C in Component 3	4.42
34	Photograph of the profile of the pit structure and the bell-shaped pit as they appeared in the north wall of the pipeline trench, Activity Area D from Component 3.	4.44
35	All flaked lithic tools recovered from Component 3	4.45
36	All cores recovered from Component 3.	4.47
37	Illustration of shaped mano fragment recovered in three pieces from Activity Area A in Component 3	4.50
38	All modified bone and shell artifacts recovered from Component 3	4.52
39	Plan map of the excavation block showing the distribution of plotted cultural remains from the three activity areas in Component 2.	5.7
40	Trend surface distributions per 1 m ² of lithic debitage, faunal remains, and fired rock from Component 2.	5.8
41	Detailed plan map of Activity Area A in Component 2.	5.11
42	Detailed plan map of Activity Area C in Component 2.	5.14
43	Plan map of the excavation block showing the distributions of plotted cultural remains from three activity areas in Component 3.	5.17
44	Trend surface distributions per 1 m ² of lithic debitage, faunal remains, and fired rock from Component 3.	5.18
45	Detailed plan map of Activity Area A in Component 3.	5.20
46	Detailed plan map of Activity Area B in Component 3.	5.22

List of Tables

<u>Table</u>	<u>Page</u>
1 Summary of radiocarbon ages for features at the Buffalo Hump site	4.6
2 Summary of lithic debitage from Component 1	4.12
3 Summary of faunal remains recovered from Component 2	4.13
4 Summary of flaked lithic tools from Component 2	4.24
5 Summary of lithic debitage from Component 2.	4.26
6 Summary of types of modified bone from Component 2 . .	4.28
7 Summary of faunal remains recovered from Component 2	4.31
8 Summary of plant macrofossils recovered from Component 2	4.33
9 Summary of the results of pollen analysis from Component 2	4.35
10 Summary of flaked lithic tools from Component 3	4.46
11 Summary of lithic debitage from Component 3.	4.48
12 Summary of types of modified bone from Component 3 . .	4.51
13 Summary of faunal remains recovered from Component 3	4.54
14 Summary of plant macrofossils recovered from Component 3	4.55
15 Summary of the results of pollen analysis from Component 3	4.57
16 Summary of lithic debitage from Component 4.	4.58
17 Summary of hypothetical attributes of model activity area types from Creasman et al. 1985	5.3
18 Summary of data relevant to hypothetical attributes of model activity area types	5.4

CHAPTER ONE · INTRODUCTION

The Buffalo Hump site (48SW5057) is a multicomponent, prehistoric habitation camp located in the northeast quarter of Sweetwater County within the Great Divide Basin of southcentral Wyoming (Figure 1). During the fall of 1985 and spring of 1986, Archaeological Services of Western Wyoming College (AS-WWC) conducted an extensive data recovery program at the site as part of the compliance requirements for the Bureau of Land Management (BLM) right-of-way grants for Exxon's Bairoil/Dakota CO₂ Pipeline, Section One, constructed from the Green River to Jeffrey City, Wyoming. The data recovery program resulted in the excavation of 318 m², which produced evidence of four occupations that occurred in the last 2000 years and represent the Late Archaic and Late Prehistoric periods. Evidence of cultural activity indicating a focus on collection and processing of plant seeds for food was recovered in the form of a number of hearth and roasting pit features and associated cultural remains. Documentation of four housepits, or pit structures, revealed the type of residence facilities used by the prehistoric inhabitants. The cultural and environmental data recovered from the investigations at the Buffalo Hump site contribute significantly to interpretations of the cultural history and prehistoric patterns of settlement and subsistence during the past 2000 years in the Great Divide Basin of Wyoming.

PROJECT BACKGROUND

The current cultural investigations at the Buffalo Hump site were initiated in the fall of 1985 when Exxon Pipeline Company proposed to construct its Bairoil/Dakota CO₂ Pipeline, Section One, through southwestern and central Wyoming. The proposed pipeline right-of-way paralleled the existing Frontier pipeline offset 35 ft south of the Frontier centerline and with right-of-way disturbance extending from the Frontier centerline to 50-75 ft south of the Exxon centerline. The cultural resource work required by the Exxon project was conditioned by the results of Frontier pipeline investigations, which had identified a number of significant historic properties on lands managed by the BLM, the state of Wyoming, and private interests. Cultural resources on federally managed lands are protected by various federal laws and regulations, including the National Historic Preservation Act of 1966, as amended, the Archaeological and Historic Preservation Act of 1974, and the Archaeological Resources Protection Act of 1979, as amended. The involved federal land managing agency (BLM) is responsible for ensuring that, insofar as possible, significant cultural resources are not destroyed or adversely affected by federally licensed projects. Therefore, in order to receive federal licensing and lease approval, the BLM required that Exxon Pipeline Company initiate a cultural resource program before construction of their pipeline.

The Buffalo Hump site had been recorded originally in 1982 during a Class III cultural resource inventory for the Frontier pipeline by Commonwealth Associates, Inc., (Roper et al. 1983:120-121). At that time, the recorded portion of the site that was exposed on the surface was evaluated as ineligible for nomination to the National Register of Historic Places (NRHP). Subsequently, an open trench inspection of the Frontier pipeline by Powers Elevation Company (PEC) resulted in the recording and the investigation of a number of significant, subsurface cultural features. The documentation on the site was amended, which

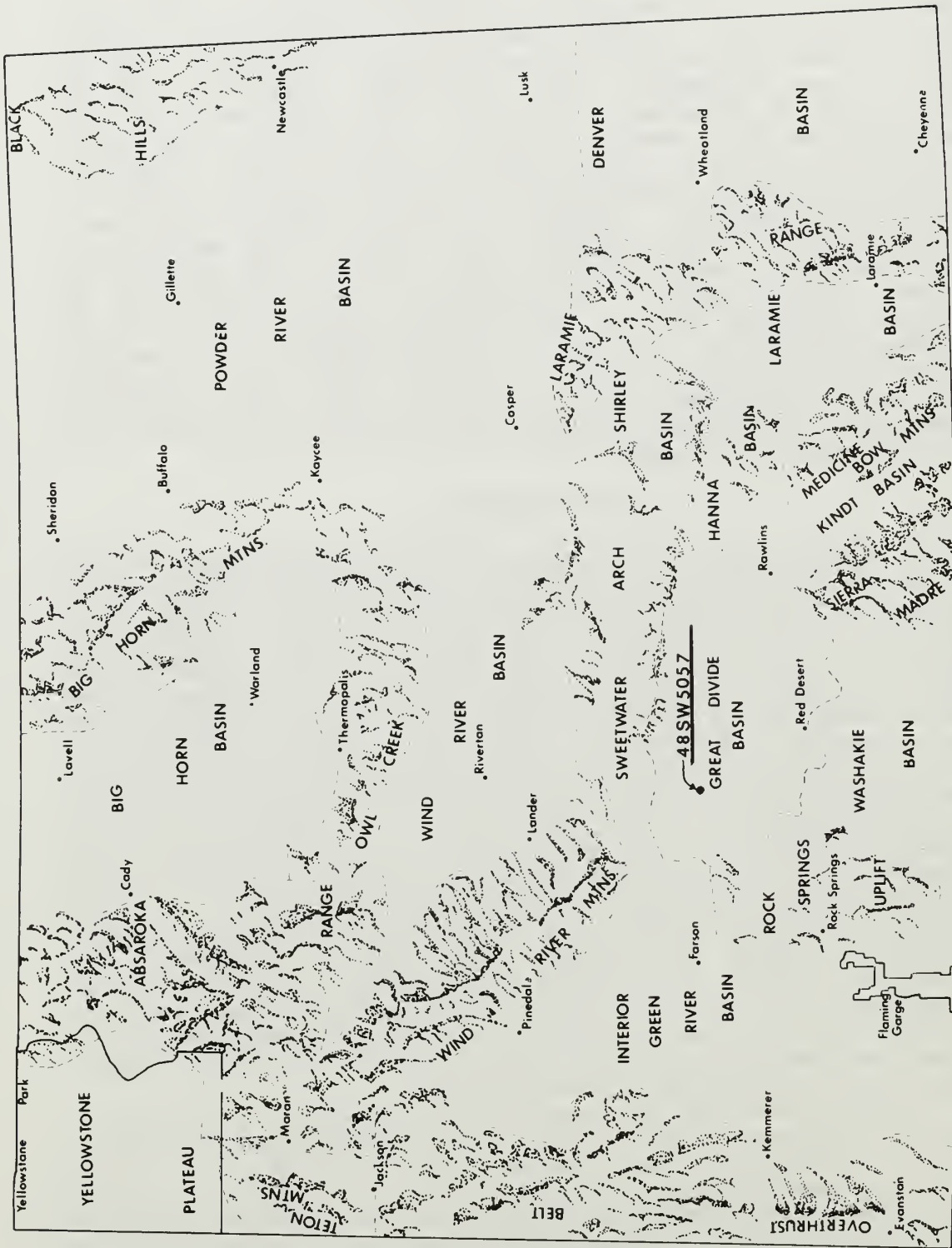


Figure 1. State of Wyoming map showing the location of the Buffalo Hump site (48SW5057).

resulted in a re-evaluation and a recommendation that the site was eligible for nomination to the NRHP (Brechtel et al. 1984). The results of the previous investigations are summarized in Chapter 2. Because the Buffalo Hump site would be directly impacted by the Exxon pipeline project, a data recovery plan (Newberry et al. 1985) was developed to mitigate adverse effects to the site. The BLM delegated the responsibility for the technical completion of this cultural resource management program to Exxon Pipeline Company under their right-of-way grant. Exxon then contracted with AS-WWC to complete the cultural resource management program for the pipeline project.

The data recovery program at the Buffalo Hump site was conducted by AS-WWC under Federal Archaeological Resource Protection Act Permit No. 084-WY-AR86 and was carried out in accordance with the Exxon Bairoil/Dakota CO₂ Pipeline Memorandum of Agreement (ACHP 1985). Field investigations were undertaken between the dates of September 24 through November 26, 1985, and April 7 through May 27, 1986, with a crew ranging in size from 2 to 17 individuals. Steven D. Creasman was the Principal Investigator. W. Mark McCallum served as the original field supervisor until May 6, 1985, at which time Lynn L. Harrell took over as field supervisor.

The data recovery plan (Newberry et al. 1985) proposed a two-phase approach. The first phase focused on exploratory excavations in the form of ten, regularly spaced, 1 x 1 m units to determine the location, depth, and nature of subsurface cultural deposits. The second phase consisted of the excavation of larger blocks, the placing of which was based on the results of the first phase. Two 10 x 10 m blocks were originally proposed to encompass any encountered hearth clusters, and two additional 4 x 4 m blocks were proposed to excavate other potential features or to connect the larger blocks if necessary. Thus, a total of 370 m² was allocated for the data recovery efforts (comprising 185 m³ if all units had been taken to an average depth of 50 cm below the ground surface). The initial plan had to be modified to accommodate unforeseen conditions, such as weather and the discovery of unique cultural features. These are explained in detail in Chapter 3 of this report. At appropriate times during the course of the investigations, the principal investigator and field supervisor met on the site with Carmel Swidler, BLM Archaeologist, Green River Resource Area, Rock Springs District, to report on the progress of the investigations and discuss modifications to the data recovery plan that became necessary due to various conditions. Work proceeded only after agreements had been reached between the appropriate representatives from AS-WWC, the BLM, and Exxon.

RESEARCH ORIENTATION

The ultimate value of an archaeological site may be judged by whether or not the data it contains contribute to our understanding of important research questions and issues. Therefore, it is important initially to formulate project-specific and regionally specific research questions and goals that will come into consideration throughout all phases of a project. The research orientation of the Buffalo Hump site data recovery program addressed two analytical levels--site-specific research questions and regional research questions. These research objectives are consistent with those outlined in the project treatment

plan for the Exxon Company, USA, LaBarge Natural Gas Project (Creasman et al. 1985:2.8-2.34), of which a brief summary follows.

Component/Activity Area Analysis

The site-specific research questions focused on the definition of the cultural components present at the site and the types of activity areas within the components. Previous investigations at the Buffalo Hump site identified several cultural components representing Late Archaic through Late Prehistoric period occupations, as these terms are defined by Creasman et al. (1985:2.6). The nature of these components suggests relatively short-term, residential occupations focused on specialized food/material processing in discrete activity areas (Creasman et al. 1985: 2.8-2.13). Following the guidance of the Exxon LaBarge treatment plan, the Buffalo Hump site data recovery program was developed as a test of the validity of these hypothesized functional assignments of activity areas and as a refinement of the definitions of what constitutes evidence of such activity. The means by which the components and activity areas were defined at the Buffalo Hump site are detailed in Chapter 3 of this report.

Regional Research Questions

Three regional research questions were posed for the LaBarge project archaeological study. Two of these were derived from previously proposed models and the third from a general statement of the relationship between subsistence adaptation change and paleoenvironmental change. The following summaries of the research questions are taken from the data recovery plan for the Buffalo Hump site (Newberry et al. 1985:117-212), which is consistent with the research orientation outlined in the Exxon treatment plan (Creasman et al. 1985:2.13-2.32).

Cultural Chronology

A major research question that was addressed by the Buffalo Hump recovery program is the validity of the recently proposed cultural chronology for southwest Wyoming (Zier et al. 1983). The availability of stratified, radiometrically dated deposits with incorporated temporally diagnostic artifacts, as was found at the Buffalo Hump site, is a critical data set for addressing this research issue.

Regional Model of Subsistence and Settlement

Another major research question that was addressed by the Buffalo Hump site recovery program is the validity of the Sanders et al. (1982) model of prehistoric seasonal exploitation of southwestern Wyoming. Site 48SW5057 is located in the Great Divide Basin, on the flank of Buffalo Hump just above Bush Creek at 2064 m (6770 ft) elevation. The Sanders et al. model suggests that basin sites are more likely to have been used in the winter when hunters and gatherers would have sought the milder weather conditions assumed to be prevalent at lower elevations. It was felt the multicomponent nature of the Buffalo Hump site could provide data useful in evaluating the stability or change in the use of basin sites during particular seasons and over a period of time.

Paleoenvironmental Change and Subsistence Adaptation Change

The last major research question that was addressed by the Buffalo Hump site recovery program was the explication of the regional paleoenvironmental history and analysis of any correlations between environmental change and the history of human subsistence and settlement within the region. Detailed analyses of site soils, stratigraphy, and pollen are important factors in addressing this major research issue. By synthesizing the data produced from analysis of sediments, pollen, and geomorphology of the site, a paleoenvironmental reconstruction was formulated, incorporating its relevance to the cultural history of the Buffalo Hump site.

CHAPTER TWO · BACKGROUND INFORMATION

This chapter provides a brief description of the environment of the Buffalo Hump site, a summary of the cultural history of the region, and a review of the previous investigations conducted at the site. Such information is essential for interpreting the results of the AS-WWC investigations at the site.

ENVIRONMENT

The discussion of environment is divided into five sections: site setting, physiography, climate, vegetation, and animals of the region. The data presented in each section is both site-specific and regionally relevant, with much of the latter derived from various documents produced by the BLM, Rock Springs District (Department of Interior 1978).

Site Setting

The Buffalo Hump site is located in the interior Great Divide Basin at an elevation of about 2064 m or 6770 ft (Figure 2) in the S½NE¼NW¼ of Section 32, T25N, R97W, in Sweetwater County, Wyoming. The site area is about 50 km due north of Table Rock, 50 km southeast of South Pass City, and 70 km southwest of Jeffrey City. This site is situated on the northeast-facing, gradual slope of a low topographic feature which culminates at a high point of 2142 m (7027 ft) on top of a small butte, or knob, named Buffalo Hump, located 5 km west-southwest of the site. The slope of the site vicinity is characterized by very low relief dissected by a number of northeast-flowing, shallow, ephemeral drainage heads, one of which forms the southeast boundary of the site (Figure 3) and another of which is located approximately 100 m northwest of the site. The slope of the topographic feature forms the southern margin of a wide, flat valley in which lie Bush, Bear, and Red creeks, all of which are intermittent drainages that flow east-southeast to the confluence of Bush and Red creeks approximately 11 km east of the site. The context of the Buffalo Hump site offers an excellent view across the valley (Figure 4), and its proximity to Bush Creek (ca. 1 km) affords easy access to a water source and the plants and animals which congregate there. Although Bush Creek is classified as an intermittent drainage, it was observed to be a viable source of water in the wet seasons during which these investigations were conducted. Otherwise, the nearest permanent source of water is in the form of springs, which are located throughout the basin, or from beneath the ground surface of dry playas which shallow excavations may expose.

Physiography

The Great Divide Basin encompasses an area of approximately 5600 square kilometers located in the south central portion of Wyoming. It is situated on the Continental Divide where the divide separates and follows uplifted formations around the periphery of the basin. The basin is an internally drained depression formed as a result of structural subsidence during the Tertiary or Quaternary periods. The major uplifts that form the boundaries of the basin are the Rock Springs Uplift to the west, the Wind River range and Sweetwater Arch to the

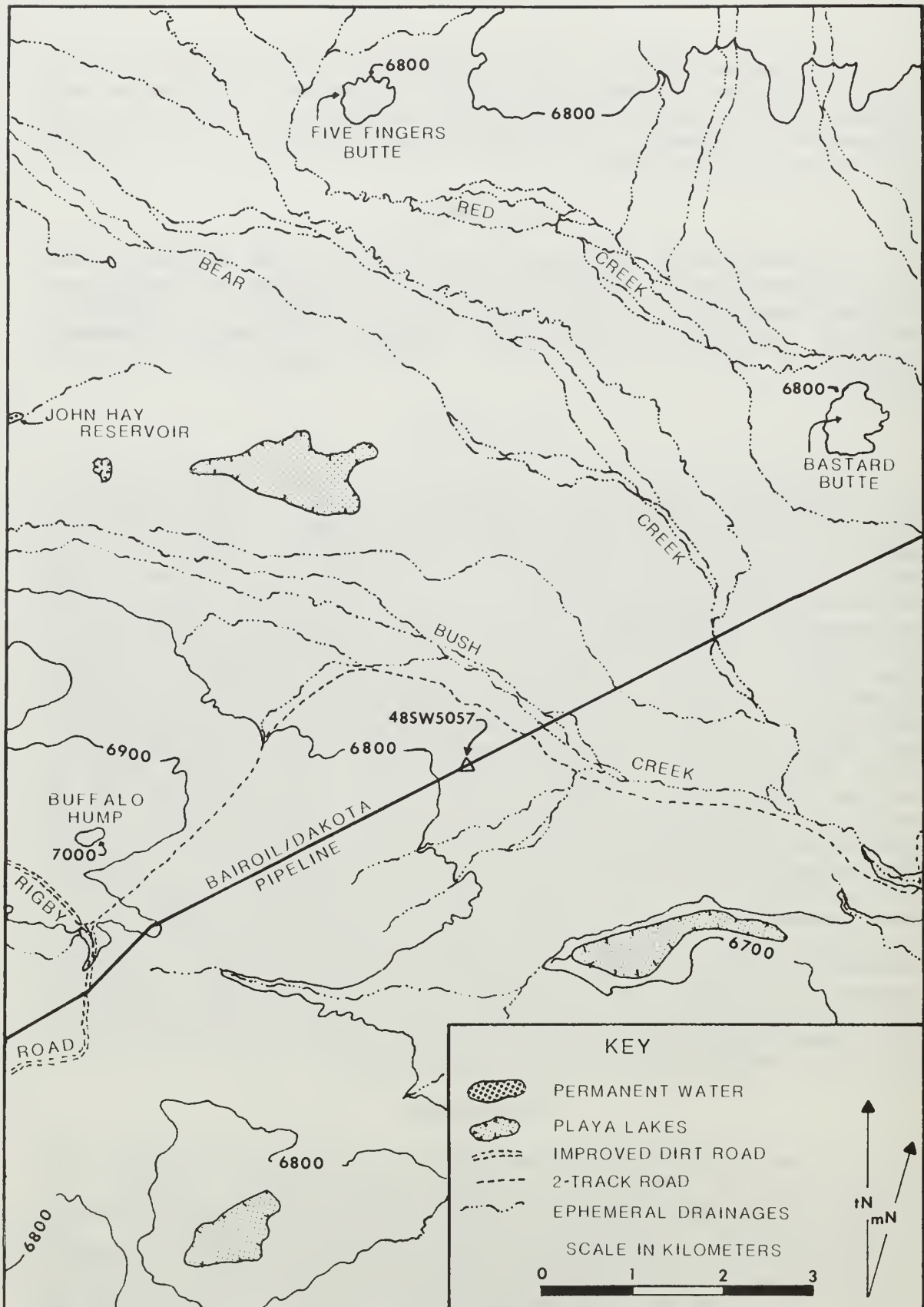


Figure 2. Topographic setting of the Buffalo Hump site (48SW5057).

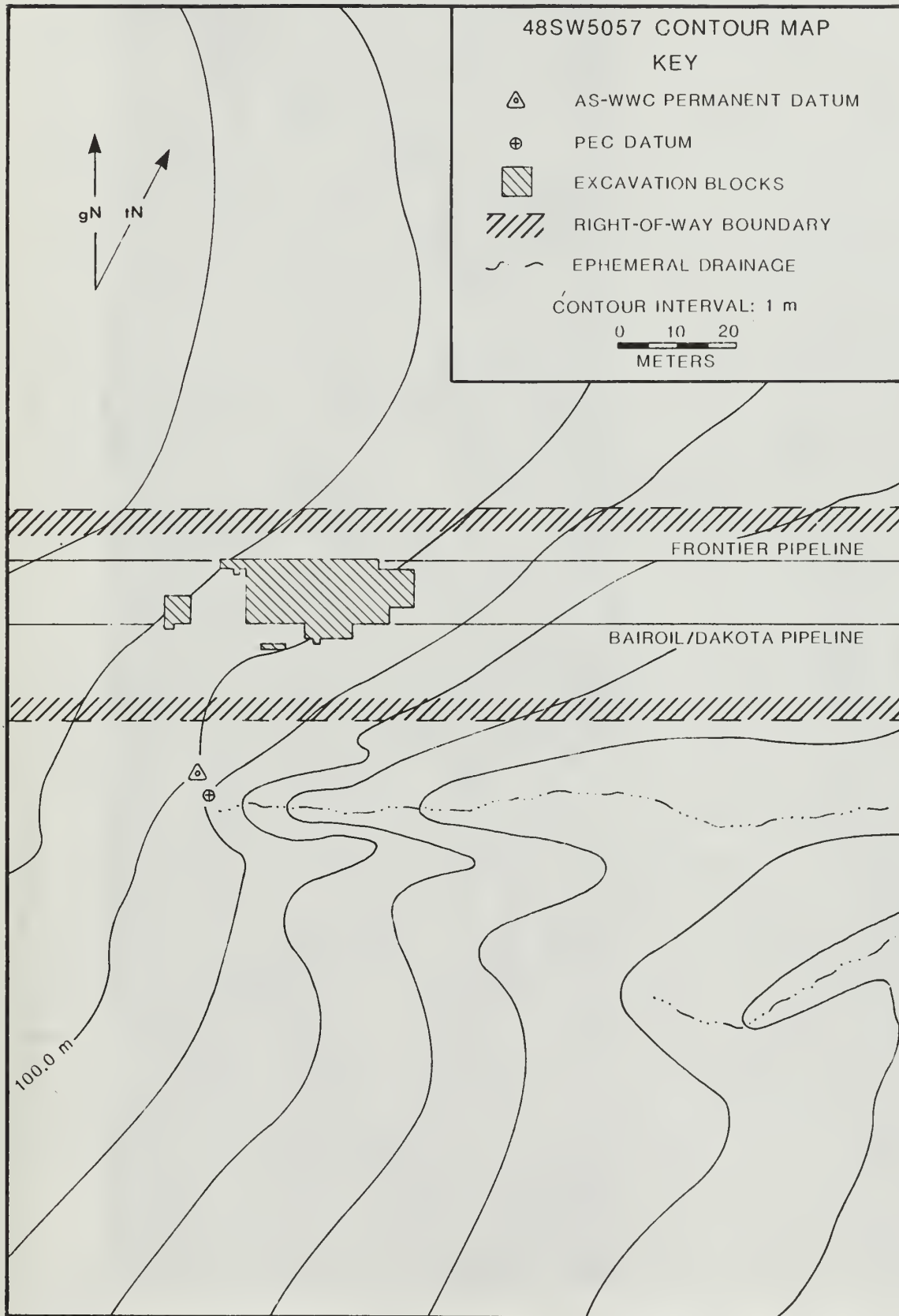


Figure 3. Contour map of the Buffalo Hump site showing the location of the excavation block.



Figure 4. View of the Buffalo Hump site showing the area of investigations before the start of excavations, looking east down the pipeline corridor toward Bush Creek.

north, and the Rawlins and Sierra Madre uplifts to the east and southeast. On the southern margin are the Delaney and Atlantic rims. Within the Great Divide Basin, low topographic relief is characteristic, and low gradient alluvial valleys drain inward to form numerous playa lakes in the interior. Sand dunes are common in the basin. These result from eolian deposition due to accelerated wind velocities funneled through this low point on the Continental Divide. The Killpecker dune field in the center of the western portion of the basin is an excellent example of this process. The Wasatch Formation, of Tertiary age, composed of mudstones and sandstones, is the dominant geologic formation exposed on the surface in the basin.

Buffalo Hump is the highest feature of an erosional remnant, the eastern flanks of which form the site's location. The eroded tableform is composed of the Tipton and Wilkins Peak members of the Green River Formation and the Cathedral Bluffs Tongue of the Wasatch Formation. Buffalo Hump itself is a weathered knob of the Cathedral Bluffs Tongue of the Wasatch Formation. The site is underlain by interbeds of the Tipton member of the Green River Formation and the Cathedral Bluffs Tongue, both of which contribute to the parent materials of the site's eolian deposits. The tablelands around the site give the appearance of a moderately dissected pediment with alluvial systems exploiting fault zones to contribute to the dissected appearance.

Climate

The following summary of modern climatic conditions is based on data compiled by the United States Department of Commerce, National Oceanic and Atmospheric Administration (1973, 1976, 1978, 1980) from various stations in the Upper Platte, Green, and Bear drainage divisions in Wyoming. Generally, the climate of the Great Divide Basin is arid to semiarid. The average annual precipitation in and around the Great Divide Basin is approximately 15 to 23 cm. The effective moisture is diminished by the high rate of evapotranspiration, which averages about 50 cm annually (Department of Interior 1978:R2-12). The period of maximum precipitation occurs in the spring and early summer with frequent, moderate to heavy snowfall from November through May. Snowfall increases dramatically with altitude. Temperatures are relatively cool, averaging about 20°C in July and -1°C in January with average daily temperature variants of 16°C in July and 10°C in January. Wind velocities tend to be moderate to strong, frequently reaching 30 to 40 mi per hour with gusts to 50 or 60; prevailing directions vary from west-southwest to west-northwest. Seasonally the area is characterized by short, warm summers with west-southwesterly winds and long, cold winters with winds prevailing from the west and northwest and frequent, moderate to heavy snowfall. The growing season is restricted by characteristic freezes in late spring and early fall; the average freeze free period is approximately 125 days.

Vegetation

The interior Great Divide Basin may be characterized generally as having a relatively restricted range of plant species that occur in widespread, homogeneous zones; and the Buffalo Hump site is no exception. In spite of the limited variety of species and communities,

a great many of the represented plants are economically useful and have been documented from ethnohistoric and archaeological contexts as important in the subsistence bases of many Native American populations. In the following discussion, an asterisk (*) indicates the genera which Yanovsky (1936) recorded as food plants of North American Indians.

At the Buffalo Hump site, two major vegetation zones are represented within a radius of about 500 m of the site. The primary zone, dominated by sagebrush* (Artemisia tridentata), occurs on the site and surrounding ridges and slopes above the valley to the east. The secondary zone occupies the valley floor itself and contains Nuttall saltbush* (Atriplex gardneri) as its primary constituent. The variable compositions of the two zones are conditioned by the nature of the soils on which the plants grow. The slopes and ridges above the valley are composed of sandy, eolian deposits, which form well drained matrices that support a variety of shrubs, grasses, and forbs. In contrast, the valley floor contains poorly drained, clayey soils, which allow accumulations of standing water to be retained during and for some time after wet periods and seasons. This property of the valley soils generally permits growth of only a few species of low forbs. Minor vegetation zones exist within each major zone, primarily within and around drainages where soils and availability of water are variable.

The upper, sagebrush zone on the sandy slopes and ridges around the site contains the greatest diversity in plant species of the two major zones. The most common of these include cottonthorn and gray horsebrush (Tetradymia spinosa and T. conescens), spiny hopsage* (Atriplex spinosa), rabbitbrush* (Chrysothamnus sp.), granite prickly gilia (Leptodactylon caespitosum), Canby and Sandberg bluegrass* (Poa bulbosa and P. sandbergii), thickspike wheatgrass* (Agropyron dasystachyum), Indian ricegrass* (Oryzopsis hymenoides), Pursh locoweed* (Astragalus aretioides), silvery bladderpod (Lesquerella ludoviciana), Holboell rockcress (Arabis holboellii), cushion buckwheat* (Eriogonum ovalifolium), wallflower (Erysimum capitatum), Hoods phlox (Phlox hoodii), sand penstemon* (Penstemon arenicola), tufted evening primrose* (Oenothera caespitosa), pricklypear cactus* (Opuntia polyacantha), and wild onion* (Allium sp.). In addition to these taxa, the small, ephemeral drainages to the north and south of the site contain greasewood* (Sarcobatus vermiculatus) and basin wildrye* (Elymus cinerus).

Moving down the slope toward the valley to the east, bud sagebrush* (Artemisia spinescens) and Nuttall saltbush* become common. Down on the clayey flats in the valley floor, Nuttall saltbush* dominates the other species found, the most common of which include wild rhubarb* (Rumex hymenosepalus), bisquit root* (Cymopterus bulbosus), fennel-leaved desert parsley* (Lomatium foeniculareum), and flaxleaf hedge mustard* (Schoenocrambe linifolia). Greasewood* and big sagebrush* grow along the banks of Bush Creek on the valley floor.

The plants represented in the immediate vicinity of the Buffalo Hump site may be limited in overall diversity, but they include a wide range of species that are economically useful to man and good forage for animals. Generally, the plants in the upper, sagebrush zone primarily supply edible resources in the form of seeds and greens. They also provide fuel for firewood and construction material for shelters. Those on the valley floor provide root stock as well as seeds and greens.

Animals

The most common large mammal in the area today is pronghorn antelope (Antilocapra americana). There is abundant documentation of the importance of antelope as a food source for prehistoric and historic aboriginal populations in the area. Several archaeological sites in the Green River Basin have produced evidence of intensive antelope use, including Austin Wash (Reiss and Walker 1982; Schroedl 1985:31-95), Oyster Ridge (Zier 1982), and Eden-Farson (Frison 1971) sites. All of these sites date from the Late Prehistoric period, although Eden-Farson may be of protohistoric age. The ethnographic record documents that large groups of Indians hunted antelope by driving the animals into brush corrals (Steward 1938:34-36; Irving 1854:259-260).

Although no longer present in the area, bison (Bison spp.) were fairly common before their near extinction in the late 1800s. Bison have been recorded at a number of archaeological sites in the Green River Basin, including Austin Wash (Reiss and Walker 1982; Schroedl 1985:31-95), Wardell (Frison 1973), and Finley (Moss et al. 1951) sites. The first two sites represent Late Prehistoric occupations, and the latter is a Paleoindian occupation.

Other smaller mammals that presently inhabit the area (Long 1965) include coyote (Canis latrans), red fox (Vulpes vulpes), badger (Taxidea taxus), bobcat (Felis rufus), striped skunk (Mephitis mephitis), long-tailed weasel (Mustela frenata), white-tailed jackrabbit (Lepus townsendii), cottontail (Sylvilagus spp.), Richardson's ground squirrel (Spermophilus richardsonii), white-tailed prairie dog (Cynomys leucurus), least chipmunk (Eutamias minimus), various voles (Microtus spp.), and deer mouse (Peromyscus maniculatus). Many of the species have been recovered in archaeological contexts in southwestern Wyoming (Armitage et al. 1982; Frison 1971; Harrell and McKern 1986; Schroedl 1985), and ethnographic sources describe the economic use of rabbits and various rodents by Native Americans in the early twentieth century (Lowie 1924; Steward 1938).

The most common game bird in the area is sage grouse (Centrocercus urophasianus), and evidence of its prehistoric use has been documented at Eden-Farson (Frison 1971) and Deadman Wash (Armitage et al. 1982) sites. Other birds include magpie (Pica pica), sage sparrow (Amphispiza nevadensis), horned lark (Eremophila alpestris), sage thrasher (Oreoscoptes montanus), Brewers sparrow (Spizella breweri), sparrowhawk (Falco sparverius), redtailed hawk (Buteo jamaicensis), and golden eagle (Aquila chrysaetos).

A few reptiles and amphibians are present in the area today, and though much less numerous than mammals and birds, were occasionally eaten by Native Americans during historic (Steward 1938:40) and prehistoric times (Reiss and Walker 1982). The most common reptiles include the eastern shorthorn lizard (Phrynosoma douglassi), the northern sagebrush lizard (Sceloporus graciosus), and the wandering garter snake (Thamnophis elegans).

The immediate vicinity of the Buffalo Hump site presently offers a fairly uniform environment occupied by a relatively restricted range of animal species. This situation seems to have persisted in the past, at least for the last 2000 years during which the site was occupied. The greatest variety of species is represented in the smaller animals, such as rabbits and rodents and their predators. Although pronghorn may

have commonly been found in large herds in the area, and probably provided a fairly stable basis in the subsistence economies of the prehistoric inhabitants of the Great Divide Basin, bison may not have been as common in the basin due to the limited amount of forage resources compared to surrounding habitats.

CULTURAL HISTORY OF THE REGION

The cultural history of southwestern Wyoming began as early as 11,000 years ago and has been the subject of study since the 1930s (Renaud 1936, 1938, 1940, and 1947). Renaud's pioneer studies of archaeology in the region served as a foundation for subsequent research. Since that time, numerous descriptions of the cultures and their chronology have been proposed (Frison 1978; Metcalf 1981; Mulloy 1958; Schroedl 1985; Sharrock 1966; Wedel 1961, 1978; and Zier et al. 1983). These cultural chronologies have become more refined recently as more data have been compiled.

Zier et al. (1983) proposed a revision of the cultural chronology of southwest Wyoming based on relative frequencies of radiocarbon determinations. Figure 5 presents a graphic summary of this chronology with comparison to the chronology for the Northwest Plains. The utility of the chronological classification by Zier et al. is limited by the restricted data base; i.e., frequencies of radiocarbon determinations with secondary attention to other cultural phenomena. However, it serves a purpose as an innovative proposal of southwest Wyoming cultural chronology and can be considered an independent data base upon which further research can build and refine.

In order to provide a general summary of the cultural chronology of the region, this report has followed the three-part temporal sequence used by Frison (1978). The three cultural periods, Paleoindian, Archaic, and Late Prehistoric, are briefly described below.

Paleoindian Period

The beginning of classic Paleoindian occupation on the Plains is generally accepted as being around 12,000 years ago (10,050 B.C.) (Frison 1978). However, archaeological evidence from southwest Wyoming indicates that the earliest occupation began around 11,000 years ago (9050 B.C.) during Folsom times (Zier et al. 1983). Paleoindian culture is distinguished by a characteristic lithic technology that produced distinctive, finely flaked projectile points that have been found in association with extinct Pleistocene megafauna in the earliest times and with evidence of intensive bison exploitation in later times. The end of the Paleoindian period is defined by changes in subsistence strategies and lithic technologies (Frison 1978). The impetus for these changes is considered to be related to a major shift in climatic conditions and environments, from mesic to xeric. The accepted date for the end of this period in Wyoming is around 7000 years ago (5050 B.C.) (Frison 1978).

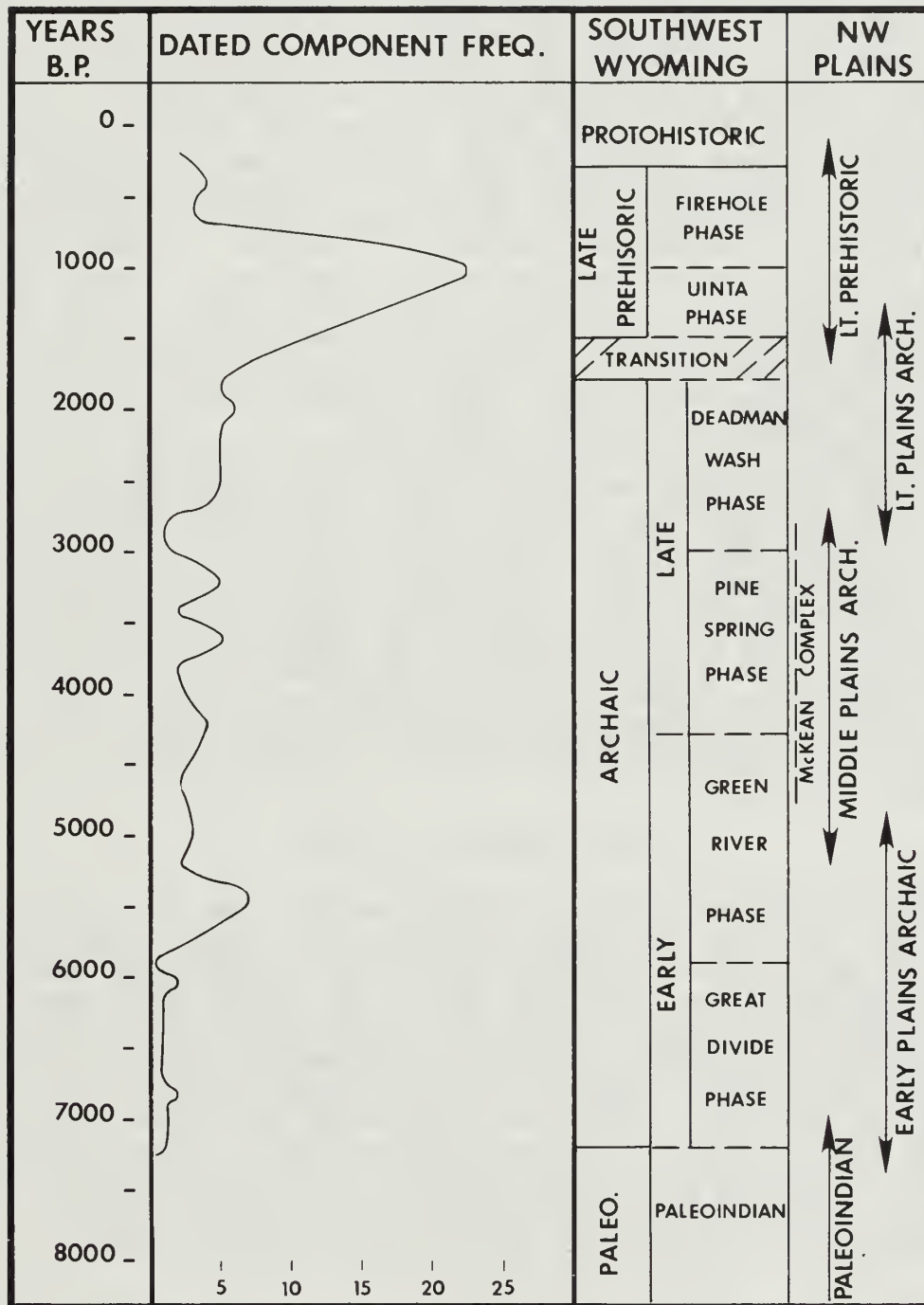


Figure 5. This figure illustrates the cultural chronology for southwest Wyoming proposed by Zier et al. (1983) compared to the scheme for the Northwest Plains (Frison 1978).

Archaic Period

This period spans the time from 7000 to 1500 years ago (5050 B.C.-A.D. 450) and apparently represents the beginning of a generalized hunting and gathering pattern that persisted in variable expressions for over 6000 years. This pattern marked an apparent shift from the Paleoindian emphasis on big game hunting to a more diversified food base that exploited a wide variety of plant and animal species. Changes were made in the technology to adapt to this new pattern. Projectile point styles became diversified and tended to have pronounced haft elements that were notched and/or stemmed. Groundstone, presumed to be used in plant processing, became more common. Other evidence of this more generalized adaptation includes the presence in sites of this period of small- and medium-sized animal bone and a variety of pit features thought to be fire or roasting pits. Very recent investigations from the last few years have recovered evidence of Archaic age semisubterranean habitation structures, or housepits, that appear to have been built between 5000 and 6000 years ago (Harrell and McKern 1986; McGuire et al. 1984; Eakin 1984).

The Archaic period has been subdivided into three segments--Early, Middle, and Late--on the basis of projectile point styles and associated radiocarbon determinations (Frison 1978). The Early Archaic period dates from about 7000 to 5000 years ago (5050-3050 B.C.), and projectile points from this period tend to be large stemmed or side-notched. The Middle Archaic period covers the time from about 5000 to 2500 years ago (3050-550 B.C.) and is distinguished by the appearance of lanceolate and stemmed projectile points, commonly with indented bases. The Late Archaic period dates from 2500 to 1500 years ago (550 B.C.-A.D. 450), and the corner- and side-notched projectile point styles tend to be smaller, more variable, and more crudely made than those from earlier periods.

Late Prehistoric Period

The Late Prehistoric period encompasses the time from 1500 to 350 years ago (A.D. 450-1600), and the projectile point styles of this period are generally considered to reflect the technological innovation of the bow and arrow. The arrow points are smaller than those from Archaic period sites and show the widest diversity of style of all the periods. The Late Prehistoric period is represented by the majority of documented prehistoric components in southwest Wyoming, and a wide variety of cultural traits are represented in these components. Ceramics first appeared in the Late Prehistoric, and stone circles are common. Archaeological and ethnographic evidence indicates that antelope became more intensively exploited in this period (Frison 1971; Reiss and Walker 1982; Schroedl 1985; Steward 1938; Zier 1982).

PREVIOUS INVESTIGATIONS AT BUFFALO HUMP SITE

The Buffalo Hump site was originally recorded in 1982 by the author of this report during a pedestrian survey of the Frontier pipeline right-of-way conducted by Commonwealth Associates, Inc. (Roper et al. 1983:120-121). At that time, minor amounts of cultural material were

exposed on the surface around an outcrop of sandstone located approximately 200 m east of where the present excavations were conducted. During this original survey, no cultural material was detected on the ground surface within the Frontier right-of-way in the area of the subsurface cultural deposits documented later by PEC and ultimately excavated by AS-WWC. The exposed, eastern extent of the site was originally recorded as a surface scatter composed of one mano, four bifaces, and one projectile point base resembling the Duncan/Hanna type of the McKean Technocomplex. On the basis of these artifacts, the site was interpreted as a multipurpose camp used for floral processing and lithic reduction during the Middle Archaic period. It was evaluated as not eligible for nomination to the NRHP due to the paucity of cultural remains exposed in a context disturbed by erosion from sheet wash and gullying.

In 1983, an open trench inspection of the Frontier pipeline conducted by PEC (Brechtel et al. 1984) revealed the presence of subsurface cultural features exposed in the pipeline trench walls approximately 200 m west of the original site location. A total of 12 distinct features or charcoal lenses was recorded in the trench walls and bladed surface of the right-of-way, and 12 small units were excavated by hand to expose the features in plan view and then salvage the data from within and directly around the edges of the features. (Figure 3 in Appendix A illustrates the location of these features in relationship to the excavations reported here.) At the time of the PEC investigations, the BLM Archaeologist for the Rock Springs District permitted the excavation of the minimum size of units required to remove the remainder of the exposed features. This resulted in the recovery of very limited data from which to formulate interpretations of the site. The sizes of the units ranged from 50 x 50 cm up to 1 x 4 m with most being either 1 x 1 m or 1 x 2 m in dimension. While some units contained no more than amorphous, ephemeral charcoal stains, others yielded multiple, well defined pit and basin features. A total of 24 discretely defined features was documented in the 12 excavation units.

The cultural remains recovered from these units are compatible with the results of the investigations and led to the same general interpretations of the site. Radiocarbon samples from three features provided ages of 1840 ± 120 years from Feature 1, 1420 ± 50 years from Feature 8A, and 1250 ± 50 years from Feature 4A. These ages indicate that the site was occupied once during the Late Archaic period and twice during the Late Prehistoric period. Artifacts included minor amounts of flaked lithic debitage and expedient tools of local raw materials; an awl made from an artiodactyl long bone fragment; and four bone beads, one of which was complete. Although no groundstone was recovered, evidence of floral processing was recovered from the fill of several features in the form of charred seeds identified as goosefoot, pigweed, pricklypear cactus, and similar types of pollen, and sagebrush. Several features contained large, intact sections of charred wood identified as sagebrush or rabbitbrush. Also, evidence of faunal processing was recovered from within and around many of the features. This was represented by fragmented bone elements from unspecified artiodactyl, jackrabbit, ground squirrel, and possibly coyote. On the basis of this culturally significant evidence, the site was re-evaluated as potentially eligible for nomination to the NRHP. This evaluation eventually led to the recommendation that further excavations be

conducted at the Buffalo Hump site prior to the construction of Exxon's Bairoil/Dakota CO₂ Pipeline, Section One.

CHAPTER THREE · METHODOLOGY

The methods applied in the field for testing and mitigation and in the laboratory for analysis, cataloging, and curation of the data from the Buffalo Hump site followed the general guidelines for data recovery as proposed in the project treatment plan (Newberry et al. 1985), which was based on the Exxon treatment plan (Creasman et al. 1985). In the following discussion of methods, those applied to the field techniques are outlined first with initial presentation of site-specific strategy followed by a summary of the general excavation and documentation techniques. Then the basic methods applied to laboratory analyses are summarized.

FIELD METHODS

Implementation Strategy

The data recovery program at the Buffalo Hump site was executed in five phases conducted during the fall of 1985 and the spring of 1986. Three of the phases involved three types of techniques for testing to determine the location and nature of the subsurface cultural deposits. The two other phases consisted of the excavation of large block areas, the implementation of which took place in two periods because weather conditions prohibited continuous work.

The first phase concerned exploratory reconnaissance to determine the exact location of the subsurface cultural deposits recorded by PEC in the Frontier pipeline trench. Initial inspection of the site by AS-WWC personnel failed to locate the PEC datum stake because the uniform, low relief of the site area afforded no distinct landmarks proximal to the previously documented cultural features. Originally the area of PEC investigations was thought to be located approximately 200 m west of where the cultural deposits were actually recorded and ultimately excavated. The first phase was initiated by excavating four 1 x 1 m test units situated along the Exxon pipeline centerline at 9 m intervals (Figure 6). This first endeavor resulted in the recovery of only one flake with no evidence of cultural features or deposits such as were documented by PEC. Therefore, subsurface exploration was initiated by excavating small (30 x 30 cm) shovel tests at 30 m intervals along the Exxon pipeline centerline (Figure 6). A total of 23 shovel tests was excavated, and the matrix was sieved through $\frac{1}{8}$ inch mesh. Three flakes were recovered from two shovel tests located in the area of the previously recorded cultural features, a fact that was verified when the PEC datum was found at that time.

The second phase entailed the excavation of 1 x 1 m test units in the area of the documented cultural strata to determine the extent and depth of the deposits. A total of fourteen test units was excavated, producing variable amounts of culturally relevant data from which the location and size of larger block units were derived. Also located at that time were the units excavated by PEC along the Frontier pipeline trench. These units were re-excavated and proved to be useful in determining the horizontal and vertical extent of the cultural deposits.

The third phase was the excavation of three large block areas (Figure 7), the location and size of which were determined by the results of previous phases. The largest block unit (Block A) was

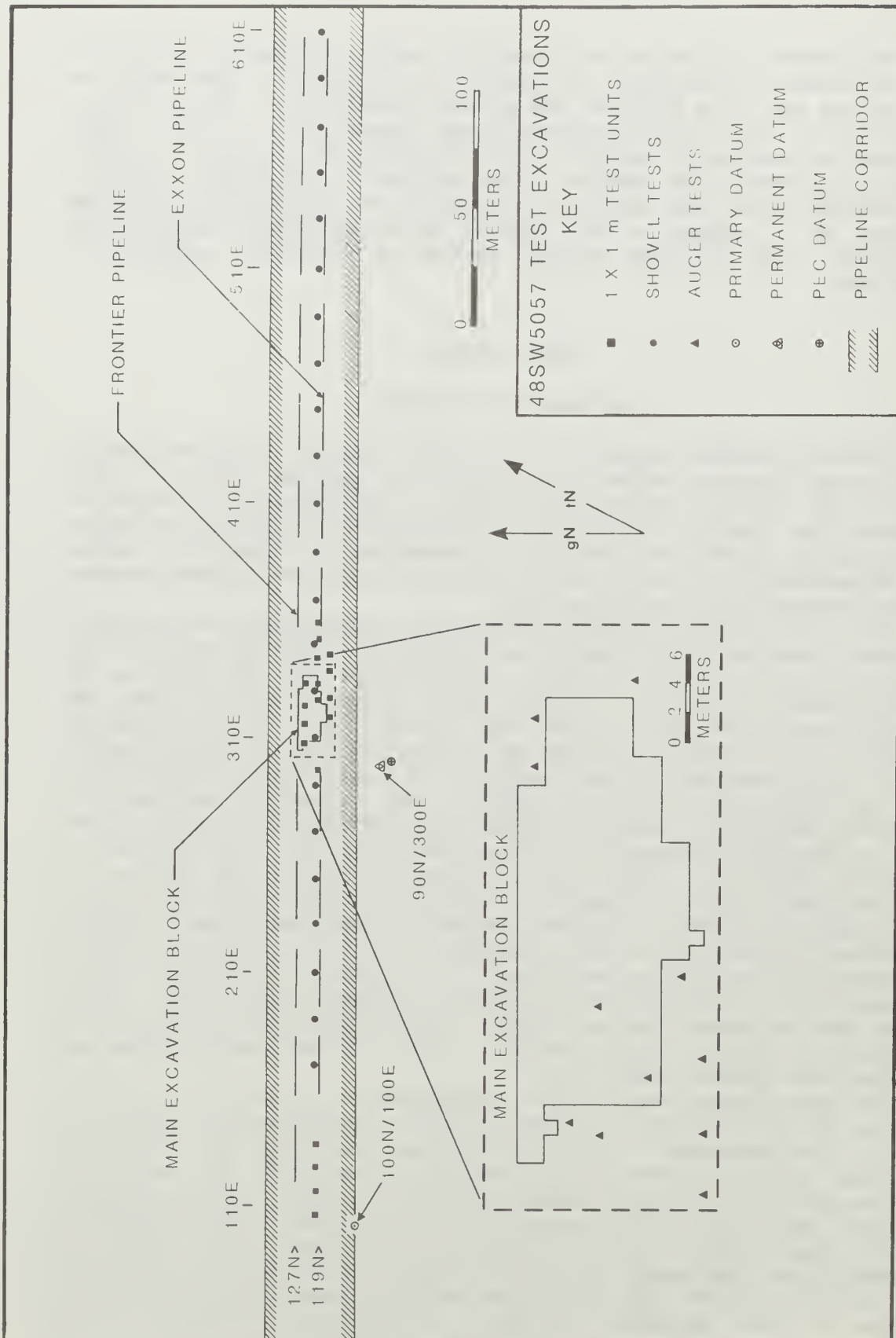


Figure 6. Map of the pipeline corridor through the Buffalo Hump site showing the location of all types of test excavations in relation to the main excavation block.

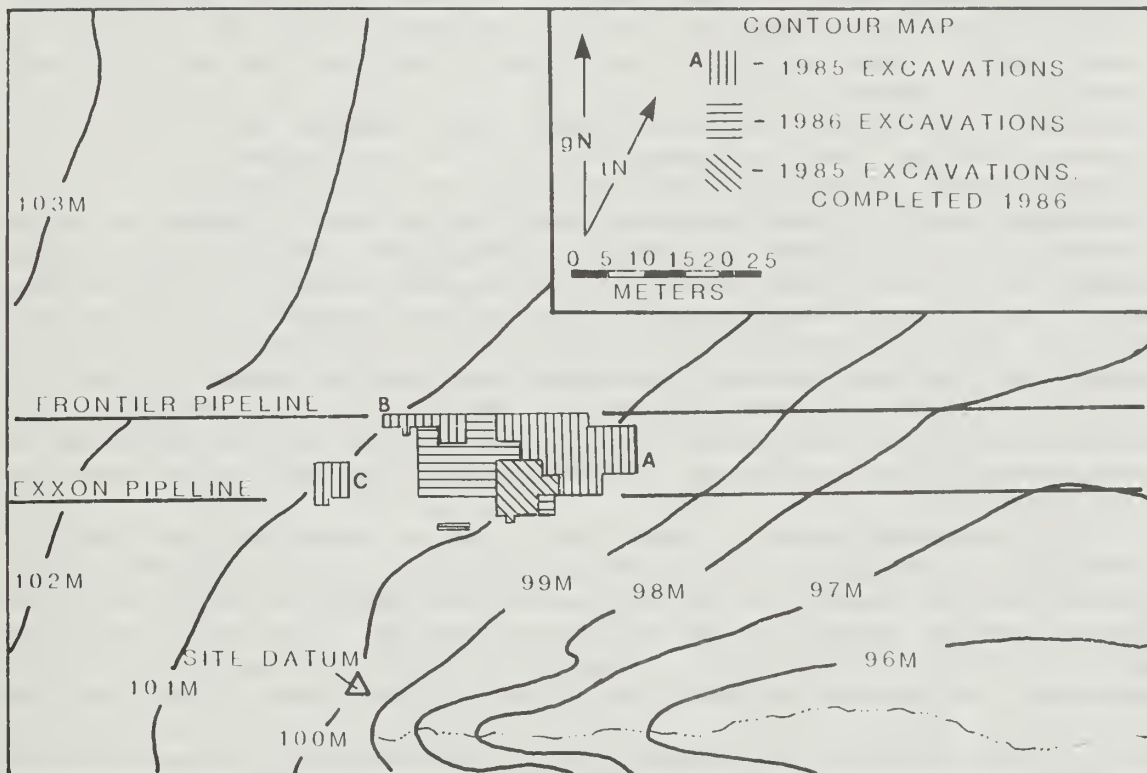


Figure 7. Map showing the locations and sizes of all block excavations conducted in 1985 and 1986 at the Buffalo Hump site.



Figure 8. View looking grid northwest of the 1985 excavations (Block A) showing how tents were used to protect excavations from snow, Buffalo Hump site.

composed of 169 m² situated between the Frontier pipeline and Exxon pipeline centerlines, in the area of highest feature concentration recorded by PEC. Blocks B and C, composed of 29 m² and 18 m² respectively, were excavated in areas where test units exhibited potential for buried cultural deposits. This phase of the program was conducted late in the fall when very poor weather conditions posed serious problems for implementation of the techniques required in archaeological excavation. Although schemes were devised to help alleviate some of these problems, such as the use of tents to cover excavations in progress (Figure 8), this phase was terminated when access to the site became impossible due to the amount of snow covering the frozen ground. At that time, the southwest portion of Block A had not been fully excavated through all cultural components. Based on the significant cultural remains documented during this phase in Blocks A and B, the data recovery program was expanded to include additional excavations in two more phases (Newberry et al. 1986:22-45) scheduled to take place in the spring of 1986 after the snow had melted and the ground had thawed.

In the fourth phase, a power auger and a manual post hole digger were used to determine the location of additional excavations that would potentially encompass other activity areas and bring the total excavated area closer to 330 m² or 370 m², as originally proposed to mitigate adverse effects to the site. Subsurface probes were dug at regular intervals in the area of Blocks A, B, and C (see Figure 6) to look for evidence of cultural deposits. At first a power auger was used, but it was quickly found to be unsuitable for this purpose because vertical control was difficult to maintain due to the mechanical aspects of the instrument. The subsequent use of a manual posthole digger proved to be more suitable for the task, particularly in the sandy deposits, because the operator could easily maintain vertical control and accurately document the depths of cultural deposits. Using the posthole digger, controlled levels were removed from the auger holes and the matrix sieved through $\frac{1}{4}$ inch mesh. This produced evidence of buried, horizontally discrete, activity areas between the three excavated blocks.

The final and fifth phase of the data recovery program entailed the excavation of the additional activity areas discovered through auger probing and completion of the unfinished portion of Block A. This phase was initiated by excavating 1 x 2 m units centered over the auger tests which produced positive results. In doing so, the remains of activity areas were exposed and excavations expanded to open a large block around the areas (see Figure 7). Also, a 2 x 2 m unit was added to the south edge of Block A, and the southwestern portion of Block A was excavated deeper to include the remainder of cultural deposits still present (see Figure 7).

The total surface area excavated during all phases of the data recovery program in 1985 and 1986 was 318 m², representing a total volume of 265.91 m³. These figures include 216 m² (170.24 m³) in Blocks A, B, and C (including seven 1 m² test units), 92 m² (83.00 m³) added to Blocks A and B in 1986 (including 1 test unit), an additional 5.88 m³ excavated in 1986 from the existing southwestern portion of Block A, and ten 1 m² test units, representing 6.79 m³ not located within the larger blocks. With the exception of one auger test, all excavations described in the five phases of the program were accomplished by manual labor

without the aid of machinery. With minor modifications specified below, formulated to fit particular contexts, the standard archaeological excavation techniques described below were applied to all phases of this investigation.

Basic Techniques of Excavation and Documentation

The first step in initiating the data recovery program was to establish arbitrary reference points from which to maintain horizontal and vertical control. Originally a primary site datum was set up 200 m west of the intended subject area and given an arbitrary horizontal designation of 100N/100E with an arbitrary elevation of 100.00 m. This datum was used as a reference point from which horizontal and vertical control was imposed on the first four, 1 x 1 m test units located out of the subject area. Once the correct area was found, a permanent site datum was established near the original PEC datum. This permanent, AS-WWC datum was placed well out of the proposed Exxon right-of-way (See Figure 3, Chapter 2) and marked by a bundle of three, $\frac{1}{2}$ inch diameter, 18 inch long pieces of rebar sunk into the ground with their top 10 cm remaining exposed. This permanent datum was given the horizontal designation of 90N/300E, consistent with the original, primary datum, and a new, arbitrary vertical designation of 100.00 m. All horizontal and vertical specifications assigned to maps, units, and data from subsequent phases of investigation were referenced to this permanent datum.

In conducting excavations, grid points were referenced back to the permanent datum, such that a point 20 m north and 20 m east of datum would be designated 110N/320E by adding the grid distances to 90N/300E. Excavation units, regardless of size, were referred to by their south-west corners, and all types of cultural remains encountered from in situ contexts were assigned the correct grid location accurate to the nearest centimeter.

Vertical control was recorded primarily through the use of a surveyor's transit and stadia rod by reference to the arbitrary elevation of 100.00 m of the datum point. For example, a grid point situated 1.25 m below the vertical datum was given an elevation of 98.75 m and a point at 1.25 m above the datum 101.25 m. In some situations, secondary vertical control points were established by driving stakes into the ground, attaching strings to the stakes at vertical points keyed to permanent datum, and using carpenter's line levels on the strings from which to measure depths related to the datum elevation. Although this method was particularly useful when excavating test units, where elevations accurate to the centimeter were not necessary, it was not suited for the precise documentation required to accurately record cultural remains because carpenter's line levels commonly produce errors of up to several centimeters. For this reason, every attempt was made to record vertical locations in the excavation blocks with use of the surveyor's transit. In order to impose a greater degree of accuracy, a permanent transit station was established by setting up a stable platform on which to place the tripod. A level area with a clear view of the excavation block and permanent datum was chosen, and three pieces of PVC pipe (2 feet long and 2 inches in diameter) were driven into the ground to form an equilateral triangle. The fully extended legs of the tripod were then inserted into the exposed tops of the pipes so that a

constant instrument height was established and maintained throughout the duration of excavations.

The basic horizontal excavation unit for documentation was a 2 x 2 m grid unit, subdivided into 1 x 1 m quadrants as collection units. This system allowed for the exposure of an area large enough to perceive and record large-scale cultural features, while at the same time, permitted the collection of cultural remains in lots from screens to be accurate to the level of a 1 x 1 m quadrant for the purpose of analyzing distributional trends. Ideally, the basic vertical excavation unit was based on natural and cultural strata when these were defined. In the absence of defined stratigraphy, particularly in test units from initial explorations, arbitrary 10 cm levels were excavated and documented. Once the cultural strata and occupation floors of components were well defined on the basis of exploratory and initial excavation units, each occupation surface was exposed completely over the entire excavation block. This allowed for visual inspection, documentation (plan maps), and photography of the entire occupation surface in the field, providing valuable feedback from which to develop subsequent strategies of investigation. Although attempts were made to follow the actual contours of the cultural occupation surfaces, this was not always possible in cases when evidence was subtle. For this reason, excavation in arbitrary 10 cm levels was integrated with the exposure of occupation surfaces in order to maintain uniform vertical control (Figure 9). As occupation surfaces became well defined through this strategy, it was possible then to eliminate the 10 cm arbitrary levels and expose the cultural surfaces on their naturally defined contours. This excavation procedure was continued until all defined cultural strata had been removed, at which time profiles were drawn of all exposed walls.

The matrix from each collection unit was sieved through $\frac{1}{8}$ inch mesh, and all artifacts (flaked stone, groundstone, modified bone and shell) recovered in lots from screens were bagged separately, by unit and class, and assigned consecutive field specimen numbers. Other remains (unmodified bone, soil, charcoal, pollen, flotation, and fine-screen samples) recovered in this manner were also bagged separately and assigned ancillary specimen numbers. Whenever possible, any of these categories of culturally relevant remains that were exposed in situ were given actual grid locations and elevations (accurate to the centimeter), bagged individually, and assigned consecutive field specimen or ancillary specimen numbers, depending on the type of remains. Fired rock encountered from both contexts (screened lots and in situ) was not collected but documented as to provenience and quantified in the field. Type of stone, size grades, quantities, and weights were recorded.

Features encountered during excavation were assigned consecutive numbers, and horizontal plan views were exposed, drawn, and photographed. Then one-half of each feature was removed, and uncontaminated soils for flotation and pollen samples were collected from the removed portion. Next, profiles and cross sections of each feature were drawn and photographed before the other half of the feature fill was removed. All feature fill not collected for samples was sieved through 1/16 inch screen; all the materials left on the screen were collected, bagged, and sent to the lab for analysis. After each feature was recorded, mapped, and its fill removed, a final photograph was taken

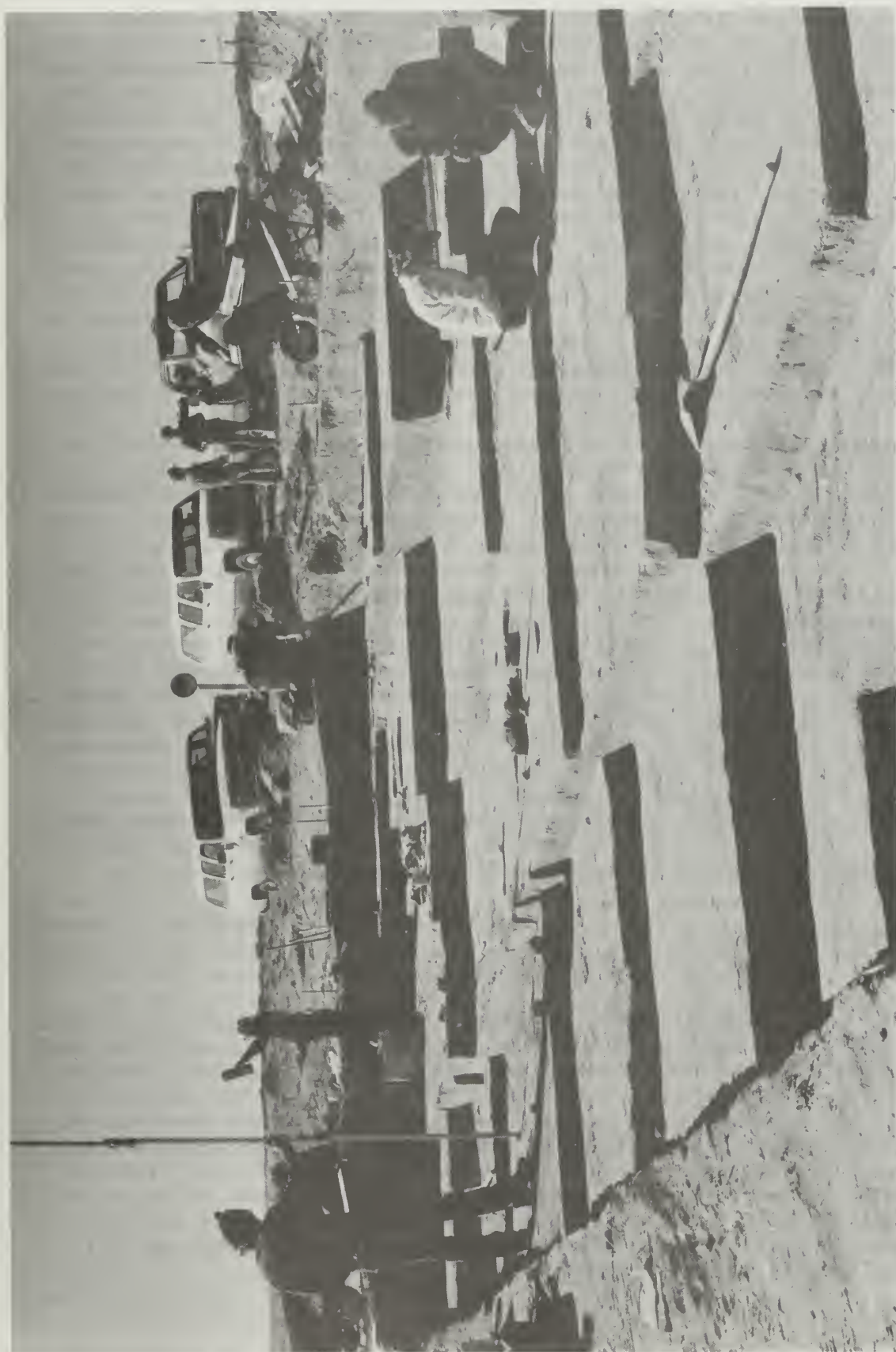


Figure 9. View looking grid northwest of the 1985 excavations (Block A) showing the excavation techniques and exposure of the entire surface of a cultural component at the Buffalo Hump site.

and another cross section was drawn along the opposing axis of the feature.

A number of special study samples were taken for the purpose of analyzing the more subtle kinds of archaeologically relevant evidence. Flotation samples were collected from interior fills of features for the purpose of analyzing plant macrofossil remains. At least 1 liter was recovered from each feature, with greater amounts from larger features, and stored in plastic bags until analysis was conducted. Pollen samples were taken from within features, and from exterior contexts consistent with the occupation floors and within 50 cm of the feature edges. Pollen samples were extracted using metal implements cleaned with distilled water and placed in clean plastic bags to minimize contamination from the modern environment. A control column for analysis of naturally occurring background pollen was taken in 10 cm increments, correlated with the natural stratigraphy, from a representative profile. A sediment column was also taken in 5 cm increments, next to and consistent with the pollen column, so that the two sets of data could be integrated to reconstruct paleoenvironmental conditions. Charcoal samples were extracted from features in uncontaminated contexts using clean metal implements to transfer them directly to packets of aluminum foil.

All samples, excavation units and levels, and cultural remains encountered during the course of investigation were documented on a number of specialized forms (Creasman et al. 1985, Appendix C). These forms were designed to elicit a great deal of detailed data and observations and ultimately were used as the primary source of data in subsequent analyses.

Any exceptions to the specified techniques and procedures were documented in detail on the appropriate forms and in the daily journal kept by the project supervisor. One exception concerned the shovel tests, which were not subject to as great a degree of vertical control as were all other excavation units. In these shovel tests, soil was extracted roughly in levels of 10 cm increments, although accuracy was limited in such small units. Another exception involved the screening of sterile overburden, which, after cultural strata were defined, was excavated without screening in much of the excavation blocks in order to expediently expose the documented cultural components.

BASIC LABORATORY ANALYSIS

Following the fieldwork, analyses of features, artifacts, faunal material, plant macrofossils, pollen, and sediments were performed in the laboratory, and these results were applied further to the definition and functional analysis of activity areas. The analytical methods applied to each class of cultural remains are discussed generally in separate sections below, beginning with a description of the cataloging and curation procedures. Here the analytical methods are presented summarily in terms of their relevance to the fulfillment of the major research themes. Details of the specific methods applied to each major class of archaeological data are presented in the appendices, where the results of each analysis appear.

Cataloging and Curation Procedures

Artifacts recovered by AS-WWC are assigned a catalog number and briefly described for cataloging purposes. The assigned catalog number begins with the AS-WWC abbreviation for the USGS topographic quadrangle on which the site occurs (e.g., Five Fingers Butte quadrangle = FFB). All artifacts, ancillary specimens, field records, and photographs are also cross-referenced to the state site numbering system. The state site number designation for the Buffalo Hump site is 48SW5057, and the AS-WWC designation is FFB18. The first artifact cataloged from Five Fingers Butte No. 18 would be FFB18.1. The decimal point is used to separate the site number from the artifact number. This method is used for all artifacts. Ancillary study specimens, such as soil samples, radiocarbon samples, pollen samples, and unworked bone, receive an additional prefix; for example, AnFFB18.1. These ancillary specimens are numbered consecutively from 1. In general, the catalog numbering order for the artifacts and the ancillary specimens follows the numbers assigned in the field, either field specimen or ancillary specimen number.

Individual chipped stone and groundstone artifacts are numbered and bagged separately. Lots of debitage, each of which may represent the material from a single level in one excavation unit, receive a single number and are bagged together. Each ancillary study specimen is numbered and bagged individually, except faunal material is usually also bagged in lots.

After cataloging, each catalog number is entered on the correct field form with separate sheets for field specimens (FS) and ancillary study specimens (ASS). In addition, the FS or ASS number is recorded on each catalog sheet. Artifacts from a single site are stored together, although delicate faunal remains are separated from groundstone artifacts and chipped stone artifacts are separated from larger groundstone pieces. The collections from sites are stored in AS-WWC's storage facility, where they are organized alphabetically by site name and then by number. Soil and flotation samples are stored in an area separate from the artifact collections, as are oversized collections and extremely large groundstone artifacts.

The completed catalog sheets are filed by site name and number in three-ring binders and are stored in the AS-WWC laboratory. All field records from large projects are placed in three-ring binders and stored in the AS-WWC laboratory. These records are referenced by project name (85-WWC-08am) and date. Site numbers are used when appropriate.

Project photographs are cataloged by site number and frame number and catalog sheets include a brief description of each photograph. These are filed by project and site for each year and stored in three-ring binders in the AS-WWC laboratory.

Examples of all standard record forms used in the field and laboratory by AS-WWC personnel may be found in Appendix C of the Exxon project treatment plan (Creasman et al. 1985).

Artifact Analysis

As has been indicated in each of the preceding sections, the analysis of the recovered artifacts is essential in each phase of this mitigation plan. To be of maximum utility, the analysis of flaked

stone, groundstone, bone, shell, and other artifacts should be done in three phases. These phases are equivalent to the basic variables that determine the final tool form. These variables are almost certainly the same for all artifact types, although to different degrees.

The three phases, or variables, of the artifact analysis are morphology, technology, and function. These variables of artifact production and use are interrelated. However, to assist in the analysis of the various processes that go into artifact production and use, the three types of attributes are addressed in separate phases.

Morphology

For the analysis reported here, it is the morphological attributes assumed to reflect artifact style that are the focus of the morphological study. Attributes of style refer to those morphological traits that do not necessarily relate to function and are presumed here to be indicative of individual cultural traditions. This is particularly true of projectile points. Attributes such as flaking pattern, blade shape, and hafting modification do not necessarily relate to function; they are presumed to be aesthetic features which may or may not enhance function. Although not necessarily related to function, these diagnostic attributes may be of great importance in evaluating the variability in cultural tradition.

The first step in the morphological analysis is an intuitive or qualitative grouping of similar artifacts on the basis of attributes of style. This grouping produces types such as side-notched projectile points, shaped manos, and slab metates. Every effort is made to avoid functional type names and connotations. Unfortunately, this is nearly impossible because the use of such terms as scraper and projectile point are a necessity for communicating clearly with the larger archaeological community. In the case of the Buffalo Hump artifacts, the relatively small sample of projectile points limits the utility of a statistical test (e.g., cluster analysis) of types. Given this limitation, some measurements (Figure 10) were used to establish basic quantified types. Ultimately the projectile points and other tool types were classified according to fundamental qualitative attributes.

Technology

Flaked Lithic Tools

An important aspect of prehistoric tool production and use is how a tool was manufactured; i.e., the stages through which a tool passed before reaching a final form. In order to understand the technological analysis, it is necessary to envision an idealized continuum of artifact production, from original core reduction to final projectile points and bifaces, through which any individual artifact must pass (Figure 11). Obviously, not all artifacts become projectile points or bifaces but instead fall out of the system at various stages according to the limitations imposed by the raw material, the ability of the flintknapper, and the intended use of the tool (Hogan 1980:87). This classification does not imply that artifacts in a particular stage were not used. Rather, it is a method of qualifying artifacts on the basis of how much energy was expended to produce them.

A technological typology has implications for prehistoric resource procurement and utilization and potentially may be a diagnostic

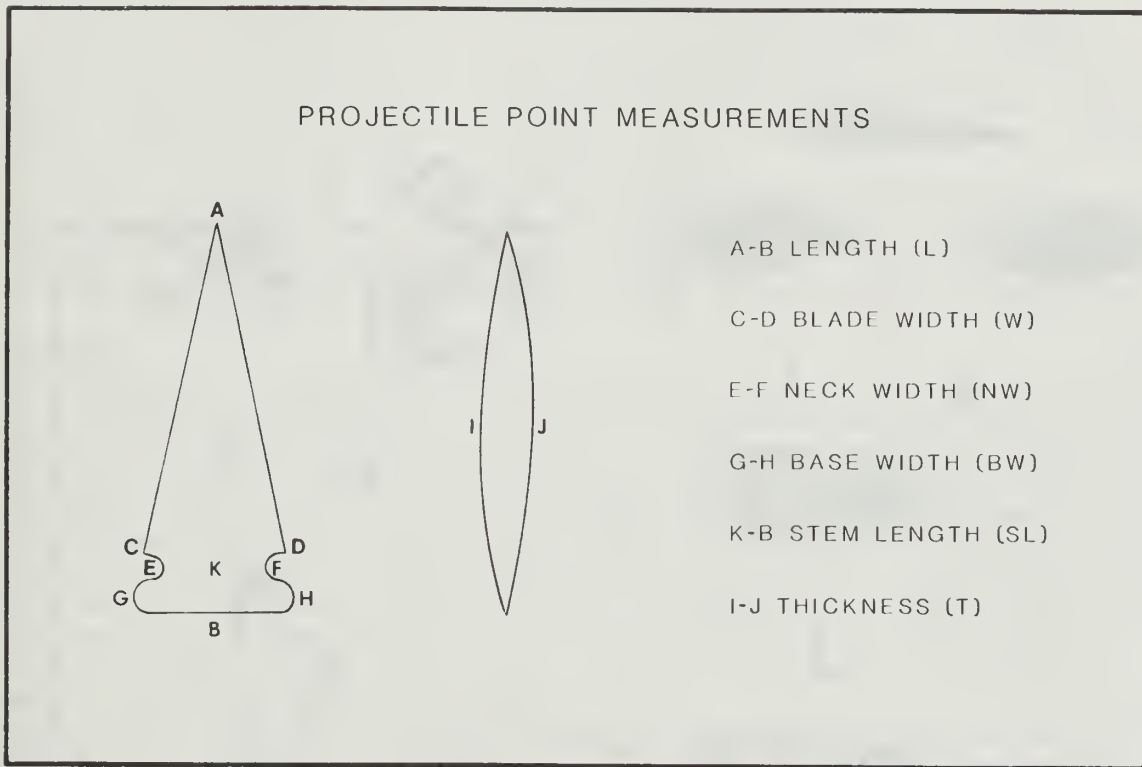


Figure 10. Illustration of measurements taken from projectile points at the Buffalo Hump site.

indication of cultural tradition. How a particular raw material is represented in the assemblage is an indication of the relative distance from the source location and the relative abundance of the material (Francis 1980; Armitage et al. 1982). If a shift in cultural tradition produces a change in subsistence, a change in the technology or manufacturing technique would be expected.

A technological classification has been a component of several AS-WWC artifact analyses, and the technological typology used for this project was based, in large part, on this previous work. The following technological type names are used to refer to the flaked stone tools from Buffalo Hump:

Utilized flake
Retouched flake
Preblank
Blank

Final biface
Projectile point
Drill

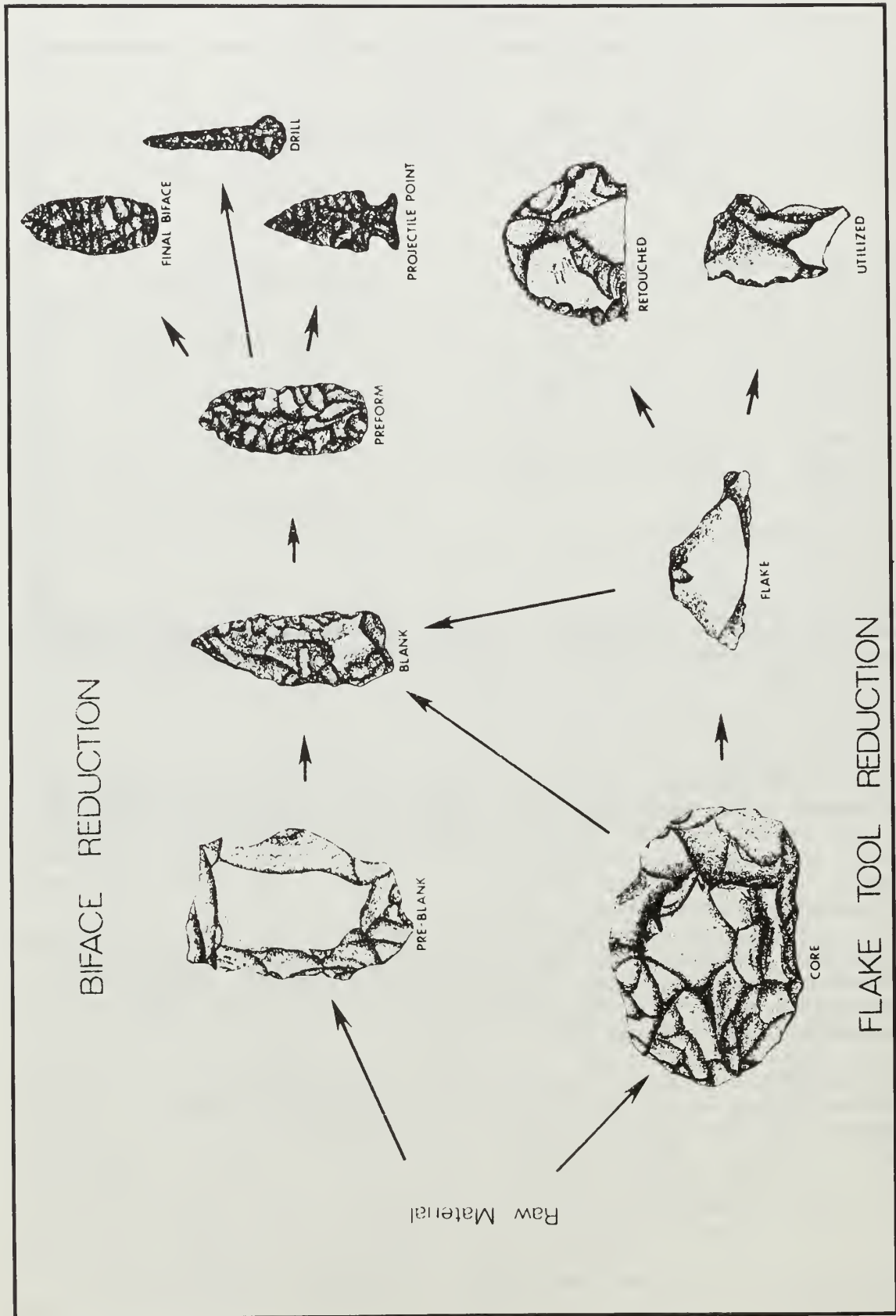


Figure 11. Illustration of idealized reduction sequence for bifaces and flake tools (Creasman et al. 1985) used in the technological classification of artifacts from the Buffalo Hump site.

These types generally appear in order of increasing energy expenditure. The relationship among these types is illustrated in Figure 11.

Of equal importance to the technological typology is a comparison of numbers representing each type; e.g., a comparison of the number of preforms and the number of blanks. A consistent representation of all types would indicate that a full range of manufacturing took place while large discrepancies between types would indicate more selective manufacturing (Armitage et al. 1982).

The construction of a technological typology will provide a characterization of how tools were produced at each site, a rough indication of the distance to and the abundance of the raw material, and, potentially, a reliable reflection of changing cultural traditions.

Debitage

Debitage, the byproduct of lithic manufacture, may also be analyzed technologically. The present AS-WWC system categorizesdebitage on the basis of size and amount of cortex. It is assumed thatdebitage generally becomes smaller and retains less cortex as production proceeds. Such a categorization ofdebitage will provide substantiating information for the flaked lithic tool technological typology; for instance, the relative abundance of mostdebitage types may indicate a full range of manufacturing activities. In addition, a simple ratio of the number of flaked lithic tools todebitage (number of tools divided by the number ofdebitage) can reveal the relative intensity of manufacture. For instance, a large number of tools and a relatively small amount ofdebitage would indicate that limited manufacture was taking place at a site. Similarly, a large amount ofdebitage and few tools may indicate that tools may have been removed from a site.

A technological classification of thedebitage from the project will have important implications for understanding prehistoric technology, especially when considered in conjunction with the flaked lithic tool technological typology.

The technological types ofdebitage are based on two criteria. The first reflects the origin of the flake on the core or object being reduced and involves the shape of the flake and amount of cortex present on the dorsal surface. The second criterion is based on the size of the flake. The specific types of flakes generated by these two criteria are described in Appendix B.

Debitage (and all other flaked lithic artifacts) are also classified according to lithic source material types. In all cases, a distinction is made between chert, quartzite, and obsidian. Other distinguishing characteristics are based on the original processes of formation of the stone as determined through attributes such as color, opacity, and internal morphology. Recently the local material types have been accurately defined and discussed by J.C. Miller (1986b). These material types are described in Appendix B.

Groundstone

A technological typology of groundstone artifacts is also possible, although it is necessarily more general than the flaked lithic tool typology. The technological typology for groundstone is also based on relative energy expenditure. As with the flaked lithic typology, the more intensive the energy expended in manufacture, the more important that tool is presumed to be to the prehistoric subsistence pattern. The

groundstone usually recovered in southwest Wyoming is not of a stylistic quality to require an involved typology; therefore, the basis of the typology is a designation of unshaped, minimally shaped, or well shaped.

Upon the completion of the groundstone technological typology, a set of types, such as unshaped mano, shaped mano, and slab metate, is produced.

Modified Bone and Shell

In the most general sense, the same kind of technological typology may be attempted for artifacts made of bone and shell. Particularly in the case of bone artifacts, a determination of the degree of modification to which a source bone has been subjected may be viewed as a reflection of the amount of energy expended to produce the artifact. The technological typology may be as simple as the definition of two types: expedient tools and formal tools. In the case of the former, fortuitously shaped bones or fragments are subject to minimal or no modification before being used. Formal tools or artifacts exhibit characteristics indicative of greater degrees of modification, in which a source bone is manipulated through a series of technological steps to reach the final form. The technological stages of manufacture may be reflected in traces of modification remaining on the final form or, more accurately, through examination of the discarded debris from intermediate stages if these are found in the archaeological remains (Harrell 1983). Because of the diversity of forms represented in elements of bone, antler, and horn and the plasticity of the source materials, no one technological sequence may be formulated that is applicable to all forms of bone artifacts. Generally it may be possible to determine the actions or forms from primary, intermediate, and final stages of manufacture, but details of each technological step may be approached only for individual types of artifact forms. The applicability of this kind of technological analysis is less suited for shell artifacts because they are so rarely found in southwest Wyoming. However, examination of individual shell artifacts may reveal traces of manufacture which may be indicative of the technological actions that produced them.

Function

Flaked Lithic Tools

The determination of actual tool function based on microscopic traces of wear has become widely accepted (Ahler 1971; Hayden 1979; Keeley 1974; Tringham et al. 1974). The scope of this project and the relatively small sample size of lithic tools prohibit a comprehensive analysis of function. Whenever possible, however, general functions were proposed based on the presence of pronounced traces of wear patterns.

Groundstone

Microscopic analysis of traces of wear on groundstone is more problematic than that on flaked lithic tools. An equally direct but simpler method for determining function is the analysis of pollen removed from the working surface of the groundstone. This methodology is described below in the section on pollen analysis, with greater detail presented in Appendix E.

Feature Analysis

Feature analysis involves basic descriptions of the morphological and functional attributes of the excavated features. The morphological attributes of a feature include its shape, both in plan and profile, dimensions (size and volume), the presence and placement of any rocks in the fill, the presence and definition of any internal fill stratification, the presence of oxidation, and the presence of any more specific morphological elements, such as a clay lining for firepit features or a stone covering for storage cists. Morphological analysis was accomplished through a description of each feature and a qualitative grouping of similar attributes.

The analysis of the function of excavated features was based on ancillary analysis of the fill itself. Feature fill was sifted and floated for faunal and macrofloral remains (charred seeds) and sampled for microfloral remains (pollen). Sampling for radiocarbon determinations was also conducted.

At the end of the morphological and functional analysis, any perceived qualitative groupings of common morphological and functional traits were compared to the recovered radiocarbon evaluations to produce a chronology of feature types with both morphological and functional attributes.

Faunal Analysis

Faunal remains are relatively direct indicators of both noncultural environment and cultural adaptation. Changes in the faunal record can be used to model cycles of environmental changes. In order to accomplish this, the faunal remains from individual, dated components must be identified to the species level. The identifications on this project were made with the aid of Western Wyoming College's and the University of Wyoming's comparative collections and written reference material such as Gilbert (1980).

To investigate cultural adaptation via faunal analysis, an evaluation of whether the remains were deposited as a result of human action is necessary. Bone associated with prehistoric features, such as bone recovered from the fill of a firepit, generally can be assumed to result from cultural behavior, as can bone with evidence of butchering marks, although the identification of cultural butchering marks can be tenuous. The same bone elements from several different individuals of the same species (e.g., the hindquarters only of several pronghorn antelope) found in association can be assumed to be the result of human activity. Because of their questionable cultural association, the ubiquitous rodent bones from this site are tabulated and discussed separately in less detail.

The analysis of the minimum number of individuals (MNI) represented by the faunal remains is used to determine how many individuals were present at the site; this allows for a relative determination of the importance of hunting and, more specifically, what species were hunted. A complementary analysis of the total weight of the different species represented in the faunal remains can substantiate a determination of the relative importance of each species to subsistence.

A determination of seasonality can be made using faunal remains. The degree of dental eruption and the stage of ossification of the

cartilage that joins the articular surface to the main body of the bone can be used to determine the age of the animal at death. Because birthing seasons are documented for many animals with seasonal reproductive cycles, the season of death, and presumably site use, can be interpreted.

In order to produce data relevant to these analytical orientations, a number of specific attributes of the bones were recorded whenever possible. These attributes and the specific analytical methods applied to them are described in detail in Appendix C.

Pollen and Macrofloral Analysis

Macrofloral (seeds) and microfloral (pollen) remains are perhaps the most environmentally sensitive materials recovered from archaeological sites. These floral remains may also provide direct evidence of subsistence activities and the season of site use. Palynological Analysts of Lakewood, Colorado, conducted the analysis of plant microfossils and Craig Smith of AS-WWC processed the flotation samples and analyzed the plant macrofossils. Detailed descriptions of the collection and analysis of these remains may be found in Appendices D and E.

The laboratory results of the analysis of pollen, soil, and flotation samples provide additional information with which to discuss paleoenvironment and cultural adaptation. Pollen alone is generally used for the determination of paleoenvironment and any changes within it. This determination is based on relative frequencies of particular pollen types. The relative frequency of these types is assessed for individual, dated components before these components are arranged in chronological order. The results are compared on an individual site basis for a particular time period and then compared on a project-wide basis through time.

The relative wetness or dryness of a particular component, and concomitantly a particular time period, can be judged on the basis of the abundance of arboreal versus nonarboreal pollen. This very general measure takes on more meaning when compared among all components through time. The confirmed increase of nonarboreal pollen at the expense of arboreal pollen, for example, will indicate a drying trend in the climate.

A more precise method for determining the same sort of climatic trends is to assess the relative abundance of specific pollen taxa for individual components, and then through all times and components. The particular environmental attributes of the plants which dominate will give a clearer definition of the environment at the time of deposition. For instance, if pollen taxa represented in later components are dominated by those from plants associated with a warm, dry climate while earlier components exhibit dominant amounts of taxa from plants associated with a wet, cold climate, an environmental shift from a mesic to a xeric regime is indicated. This method is obviously similar to the faunal succession suggested in the preceding section and is, in fact, based on the same premise, that changes in the environment will produce detectable changes in the faunal and floral remains.

Subsistence adaptation can be understood based on both pollen and macrofloral remains, but these remains must be from a cultural context. The differentiation between cultural and noncultural floral remains is

based on the location of the deposited remains. Pollen, seeds, and fiber found within features and adhering to artifacts (groundstone) and feature material (slabs) can be assumed to be cultural. In addition, comparison of remains recovered from within the site to a stratigraphic column from off the site may reveal the presence of pollen in only the site sample, indicating its transport to the site by cultural means. Within the plants determined to be cultural, a frequency count again can be used to determine the relative importance of each species to the subsistence pattern.

A final use for the identified floral remains is a determination of seasonality. The general life cycles and maturation dates of particular plants are documented, and the part of the plant deposited archaeologically can be used to define season of use. For instance, if the seeds of a plant which produces seeds during the fall are recovered from a site, then autumn is the indicated season of use and site occupation. Nevertheless, there are problems with a straight correlation between the two. Seeds found in a storage feature may have been stored long after they were procured. On the other hand, seeds found within features or associated with living surfaces may indicate season of procurement more directly.

Floral remains, of both types, can be used to make a more specific determination of environmental change than faunal remains. They can be used to determine which plants were procured and processed as a part of subsistence activities, which types were relatively more important to the overall subsistence adaptation, and, finally, the season of plant and, by inference, site use.

The results of the analyses of both macrofossil and microfossil plant remains appear in Appendices D and E. The specific laboratory methods are included in the appropriate appendix.

Sediment Analysis

By forming the matrix in which archaeological information is found, sediments represent an important aspect of site interpretation. Sediments can be used to form important indices in assessing paleoenvironmental change, but only inferentially can they affect interpretations of subsistence adaptations. Nonetheless, the constituent elements of sediment morphology form an important tool in measuring the effects of environment on man's adaptation.

Analysis of sediments extracted from column samples in 5 cm continuous increments was conducted at the AS-WWC Geoarchaeology Laboratory. Sediment analysis include the assessment of grain size populations, organic carbon, total carbonates, pH, conductivity, angularity and sphericity, and mineralogy. The results of the sediment analysis may be used to reconstruct the paleoenvironmental and depositional history of the site. A detailed description of the methods and results of the sediment analysis appears in Appendix F.

Component/Activity Area Analysis

Creasman et al. (1985) proposed a model of hypothetical activity area types. In the model, three activity area types are defined on the basis of general and specific attributes hypothesized for each type. The three ideal types are floral processing, faunal processing, and

residential. The attributes of each activity area type also represent the data required for testing the model. The more general aspects of the model were based on Binford's (1978, 1980, and 1983) ethnographic research relating to archaeological site formation, with the more specific attributes derived from the existing data base of prehistoric sites in Wyoming. The validity of the model is evaluated by testing the attributes assigned to these hypothetical types through the data recovered from the Buffalo Hump site. A more detailed discussion of the model and its relation to these data is presented in Chapter 5.

Briefly, 14 attributes were distinguished to define the three ideal types of activity areas. The relationships of specific site data to the criteria defined for the attributes is examined to determine functional types of activity areas. Attribute 1 addresses the presence of hearths, which is a requirement of all three ideal types. Attribute 2 concerns presence or absence of anvils, hammerstones, fleshing tools, and/or cleaver/choppers, which should appear only in the faunal processing type, whereas presence of groundstone (Attribute 3) is a trait only of the floral processing and residential types. Attribute 4 deals with the results of pollen washes of groundstone, which should be positive for floral processing, positive and negative for residential, and not applicable to faunal processing. Attribute 5 relates to the economic plant remains recovered from features, which should be positive for floral processing and residential types and negative for the faunal processing type. In Attribute 6, the plant remains from occupation floors should be similar to that from features in floral processing and residential types and dissimilar in the faunal processing type, but the same as background pollen rain only in the faunal processing type. Attribute 7 addresses the index of groundstone to flaked lithic tools computed by the formula: number of groundstone tools divided by number of flaked lithic tools, multiplied by 100. This index should be greater than 10 for floral processing, less than 2 for faunal processing, and between 2 and 10 for the residential type.

Attributes 8 through 11 concern the quantities and nature of faunal remains. In Attribute 8, the number of represented economic species should be two or fewer small to medium animals and one or fewer large species for floral processing, more than one large species for faunal processing, and a total of three or more of any species for the residential type. In Attribute 9, the percentage of skeletal remains from large game species is calculated by dividing the number of observed bone elements of a species by the total number of bones in the skeleton of that species and multiplying this index by 100 to derive percentage. In the floral processing type, this index should be less than 20%, it should be greater than 50% in the faunal processing type, and between 20% and 50% in the residential type. Attribute 10 concerns butchering units in large game species, which should be represented only in the residential type and absent from both floral and faunal processing types. In Attribute 11, bone elements that are crushed and broken should be present only in the faunal processing type and absent from the others.

Attribute 12 proposes variable percentages of specific technological types of flakes within the total sample of flaked lithic debitage for each type of activity area. These percentages are detailed in Chapter 5, Table 17. Attribute 13 addresses the diversity of flaked lithic tool types, computed by the formula: number of types observed in

the specific sample divided by the total possible number of tool types, using the number 13 for the latter, based on the number of technological types defined by AS-WWC (1983:9-10). The diversity of lithic tool types should be lowest for floral processing and highest for residential, with an intermediate number for faunal processing. Finally, Attribute 14 acknowledges that cultural material should occur in patterned distributions for all three activity area types. Obviously, this trait is a necessary requirement in order to attempt functional analysis of activity area, which must be defined by patterned distributions in the first place.

Definition of cultural components within a stratified archaeological site is generally determined by the amount of concentrated cultural debris and features present within a cultural stratum. Where cultural components exist within the same stratigraphic unit, with no obvious visual distinctions, other criteria are necessary in order to recognize the specific components. One way of defining these components is through the analysis of feature attributes and spatial distribution of cultural material.

By defining specific feature attributes, one may be able to group certain types of features with a specific cultural component. Unfortunately, this system has obvious limitations. There are relatively few feature types that represent a variety of activities, so one feature type may potentially reflect any one of a number of activities from any component. By integrating feature analysis with spatial distribution of artifacts, a more refined definition of a cultural component may be revealed.

There are a number of ways to analyze the spatial distribution of artifacts. When a number of specimens are recovered from in situ contexts, patterns of features and densities of artifact lots may be evident when these are integrated with spatial distributions of other cultural remains. One way of dealing with densities of artifact lots from grid units is to use trend surface analysis (Hodder and Orton 1976: 155) to smooth out sharp discrepancies and create graduated contours of densities.

For this project, trend surface analysis was used to analyze the spatial distribution of lithic debitage, bone, and fired rock recovered in screens as lots from 1 m² units. A trend surface analysis of the flaked lithic tools was not possible, due to the small sample size. Total counts of debitage and bone and total weights of fired rock from 1 m² units were used as the basis for calculations. The method simply produces an adjusted value for each unit by calculating its average in relation to the surrounding units. This is done by taking the value of a 1 m² unit and adding it to the value of every adjacent unit. The sum is then divided by the number of units whose values were used to produce the sum. The averaged, adjusted values are then assigned to the units and used to draw contours of graduated densities of the examined remains in much the same manner as elevation contours are drawn on maps.

CHAPTER FOUR · RESULTS

This chapter presents the results of the analyses of the various categories of culturally relevant remains by summarizing the data associated with each cultural component. Detailed discussion of the results of each analysis appears in the appendices. After a discussion of the stratigraphy and sediments, each of the four cultural components is described with attention to the cultural activities and patterns reflected in the analyses of the different types of archaeological data.

STRATIGRAPHY

The cultural strata at the Buffalo Hump site are situated in eolian deposits which aggraded in a shadow on the southeast side of a low topographic feature. Initially these shadow deposits began by filling the depression of a drainage head, formed during the Late Pleistocene or early Holocene, and then continued through a series of cycles of deposition and deflation to reach the present surface configuration. Originally the degree of slope on the northern edge of the old drainage head was greater than at present, and as deposits aggraded on this slope, the degree of incline decreased and the drainage head was moved south to its present location.

The stratigraphy is represented generally by a series of eolian, sandy deposits which are separated primarily on the basis of highly visible disconformities or deflated horizons (Figure 12). In the following descriptions of individual strata, generalized field observations are presented. Greater detail based on the results of sediment analysis is presented in Appendix F. The results of sediment analysis identified two major stratigraphic zones, the lower being a poorly sorted, silty fine sand equivalent to Stratum II (described below) and the upper being a moderately well sorted, homogeneous, fine sand equivalent to Strata III through X below. Stratum I, the regolith bedrock, was not addressed in the sediment analysis, and Stratum XI is interpreted as representing a coppice dune or mobile sheet with a minor marl near its upper surface. Because of the very different natures of geologic sediment analysis and archaeological field observation of stratigraphy, the two sets of data are not identical. The primary emphasis of archaeological stratigraphic definition is the identification of cultural zones and the vertical and horizontal orientation of these zones within a site. The following descriptions of strata recorded in the field emphasize the nature and provenience of cultural strata. Geologic interpretations of the stratigraphy are detailed in Appendix F.

Stratum I

Stratum I (not illustrated in Figure 12) occurs directly below Stratum II in the sediment column at a depth of 1 m below present ground surface (BPGS) in the southern margin of the excavation block and as shallow as 50 cm BPGS on the northeastern corner. It represents the regolith bedrock, which is the Tipton member of the Green River formation. This stratum, which predates eolian deposition, appears as reddish-brown clay with abundant gray-green clay platelets.

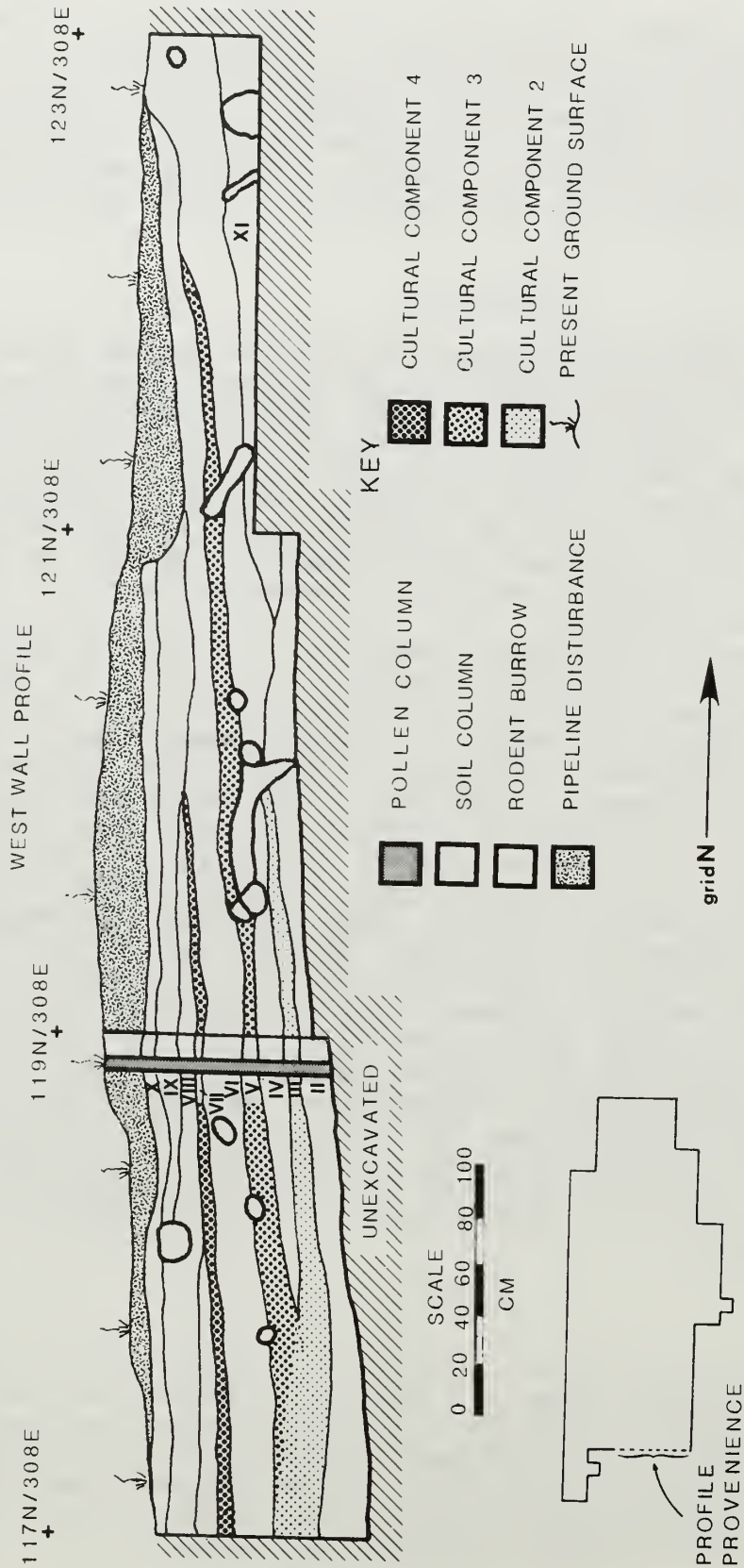


Figure 12. Representative profile of the west wall of the 1986 excavation block showing the stratigraphy typical of the entire block area, with graphic illustration (upper) and photographic illustration (lower) of the same profile at the Buffalo Hump site.

Stratum II

Stratum II is a yellow-brown, moist, clayey sand which represents the beginning of eolian deposition/deflation in the old drainage head. Sandy soils from above are mixed with the clayey regolith from below. It contains gray-green clay platelets and sandstone gravels and exhibits minor amounts of charcoal flecking in its upper portion due to leaching from the overlying cultural stratum.

Stratum III

Stratum III is a grayish-tan sand with poorly sorted fine- to medium- grained particles and abundant flecks of charcoal. Cultural Component 2, with a radiocarbon age of 1480 ± 60 years, is represented in this stratum.

Stratum IV

Stratum IV is composed of yellowish-tan, fine- to medium-grained, poorly sorted sand. It represents the basic composition of the remainder of the overlying, sterile, eolian deposits.

Stratum V

Stratum V is a grayish-tan, fine- to medium-grained, poorly sorted sand with abundant flecks of charcoal. Cultural Component 3, with three radiocarbon ages of 1300 ± 100 , 1290 ± 60 , and 1250 ± 60 years, is represented in this stratum.

Stratum VI

Stratum VI is composed of the basic, yellowish-tan, fine- to medium-grained, poorly sorted sand.

Stratum VII

Stratum VII is a light grayish-tan sand with poorly sorted, fine- to medium-grained particles and minor amounts of charcoal flecking. It represents the most recent cultural component, Cultural Component 4, from which no radiocarbon age was obtained.

Stratum VIII

Stratum VIII is the basic eolian deposit represented by yellowish-tan, fine- to medium-grained, poorly sorted sand.

Stratum IX

Stratum IX is similar to Strata IV, VI, and VIII but differentiated because of a slightly pink tinge to its color.

Stratum X

Stratum X represents the uppermost, modern deposit and root zone. It is unconsolidated, brown, fine- to medium-grained, poorly sorted sand with abundant organic materials.

Stratum XI

Stratum XI occurred only in the northern portion of the excavation block and is shown in Figure 12 on the right end of the profile. It is composed of the basic eolian deposits but is distinguished because of its very high content of calcium carbonate causing it to be extremely indurated and resulting in the common formation of frost and/or dessication cracks.

COMPONENT DEFINITION

Cultural components are generally defined through visual inspection of both vertical and horizontal distribution of their remains. Originally in the field, two components (Components 2 and 3) appeared as well defined, gray-stained strata separated by a sterile, tan stratum, a pattern that covered most of the excavation block. A third component (Component 1) was also documented during excavation as a horizontally restricted area in the center of the block that occurred below Component 2. Ultimately, after analysis of the cultural remains and stratigraphy, a fourth component (Component 4) was distinguished as a poorly defined occupation just below the present ground surface. With the exception of the cultural material collected from various test units located distant from the excavation block, all other cultural remains were correlated with the four components on the basis of stratigraphy, primarily, with consideration of horizontal distributions and associations.

The radiocarbon ages of three of the components conform to their stratigraphic relationships. The uppermost, ephemeral component contained no datable remains, although its stratigraphic location places the occupation sometime after about 1250 years before the present (B.P.). The radiocarbon ages of the three dated components correlate well with the radiocarbon estimations from features recorded by PEC in the Frontier pipeline trench. In Table 1, all radiocarbon estimations from all investigations at the Buffalo Hump site have been compiled and corrected according to the dendrochronological correction curves (Klein et al. 1982). All the corrected radiocarbon ages were then compared using the F statistic in the manner defined by Long and Rippeteau (1974). The ages which showed the greatest probability of contemporaneity, according to the F statistic, were then grouped together and used to calculate an average age for each dated cultural component (Long and Rippeteau 1974).

The radiocarbon evidence indicates that the site was occupied at least three times in the last 2000 years. Near the end of the Late Archaic period, Component 1 represents an occupation with a radiocarbon age of 1870 ± 80 years (Beta-14887) obtained from Feature 4. A similar age of 1840 ± 110 years (Beta-7988) was documented from one of the PEC features located over 35 m west of Feature 4. Component 2 represents an

Table 1. Summary of radiocarbon ages recovered from the Buffalo Hump site, showing corrected and averaged ages.

Sample Sources	Beta Analytic Sample No.	Radiocarbon Age* from Beta	Corrected Radiocarbon Age* (Klein et al. 1982)	Average Radiocarbon Age* (Long and Rippeteau 1974)
Component 1				
Feature 4 ^a	Beta-14887	1870 ± 80	1852 ± 121	1800 ± 79 F = 0.33
Feature 1 ^b	Beta-7988	1840 ± 120	1762 ± 104	
Component 2				
Feature 24 ^a	Beta-14890	1480 ± 60	1425 ± 50	1406 ± 33 F = 0.28
Feature 8A ^b	Beta-7990	1420 ± 50	1390 ± 45	
Component 3				
Feature 49 ^c	Beta-17206	1300 ± 100	1212 ± 79	1202 ± 35 F = 0.018
Feature 17 ^a	Beta-14889	1290 ± 60	1210 ± 68	
Feature 30 ^a	Beta-14888	1250 ± 60	1195 ± 68	
Feature 4A ^b	Beta-7989	1250 ± 60	1195 ± 68	

* In years before present, with standard deviations expressed to one sigma

a This report

b Brechtel et al. 1984

c Burchett 1987

occupation that occurred during the early part of the Late Prehistoric period with a radiocarbon age of 1480 ± 60 years (Beta-14890) from a bell-shaped pit located within a pit structure. This age correlates with the PEC date of 1420 ± 50 years (Beta-7990) obtained from a nearby feature from a compatible stratigraphic context. In Component 3, two radiocarbon estimations of 1290 ± 60 years (Beta-14889) and 1250 ± 60 years (Beta-14888), taken from a bell-shaped pit in a pit structure and a bell-shaped pit from an exterior activity area, respectively, place this occupation in intermediate Late Prehistoric times. A corresponding age of 1250 ± 60 years (Beta-7989) was produced in a PEC feature from consistent vertical and horizontal provenience.

The ages and stratigraphic relationship of Components 2 and 3 conform with the geomorphological sequence of deposition on the site. The geomorphology indicates that the depression created by an old subsurface drainage head was filled by aggradation of eolian deposits. The gradual slope of the present ground surface contrasts with a greater slope in the same direction that was present at the time of original formation of the drainage head. The degree of slope diminished as deposits aggraded in the depression. During the times of Components 2 and 3, the lower and middle portions of the northern slope of the depression were occupied, probably because of shelter from prevailing winds. This pattern of occupation produced wide bands of cultural deposition aligned with the contour of the existing slope. Stratigraphically, Component 2 is situated below and downhill, or southeast, of Component 3 (Figure 13), exemplifying this pattern of occupation on the contour of the old slopes. This pattern is also reflected in the remains of Component 4, which generally conforms with the more gradual slope of the present ground surface.

The stratigraphic configuration of Component 1 is not consistent with this pattern. The occurrence of Component 1 in two isolated areas prohibits the distinction of clear stratigraphic associations. Some portion of the old slope appears to have been occupied in at least two separated areas. Subsequent erosion may have disturbed any remains which may have connected the two areas, or, at the time Component 1 was occupied, the cultural activities were segregated into isolated loci.

Component 1

This oldest component, Component 1, is represented in one area within the excavation block and by one feature from the Frontier pipeline trench. In the excavation block, Feature 4 produced a radiocarbon age of 1870 ± 80 years, and Feature 1, documented by PEC (Brechtel et al. 1984) from about 35 m west of Feature 4, yielded a similar radiocarbon estimation of 1840 ± 120 years. Based on this evidence and on the minor amounts of cultural debris associated with these features, Component 1 appears to have been a short-term occupation that represents one or two episodes of activity, as reflected in the cultural features.

Features

One large, oxidized, basin-shaped pit, Feature 4 (Figure 14), was documented in the excavation block from Component 1. This type of feature may have been used as a hearth or roasting pit, the oxidation being produced from the fire and/or coals within the pit. Charred seeds

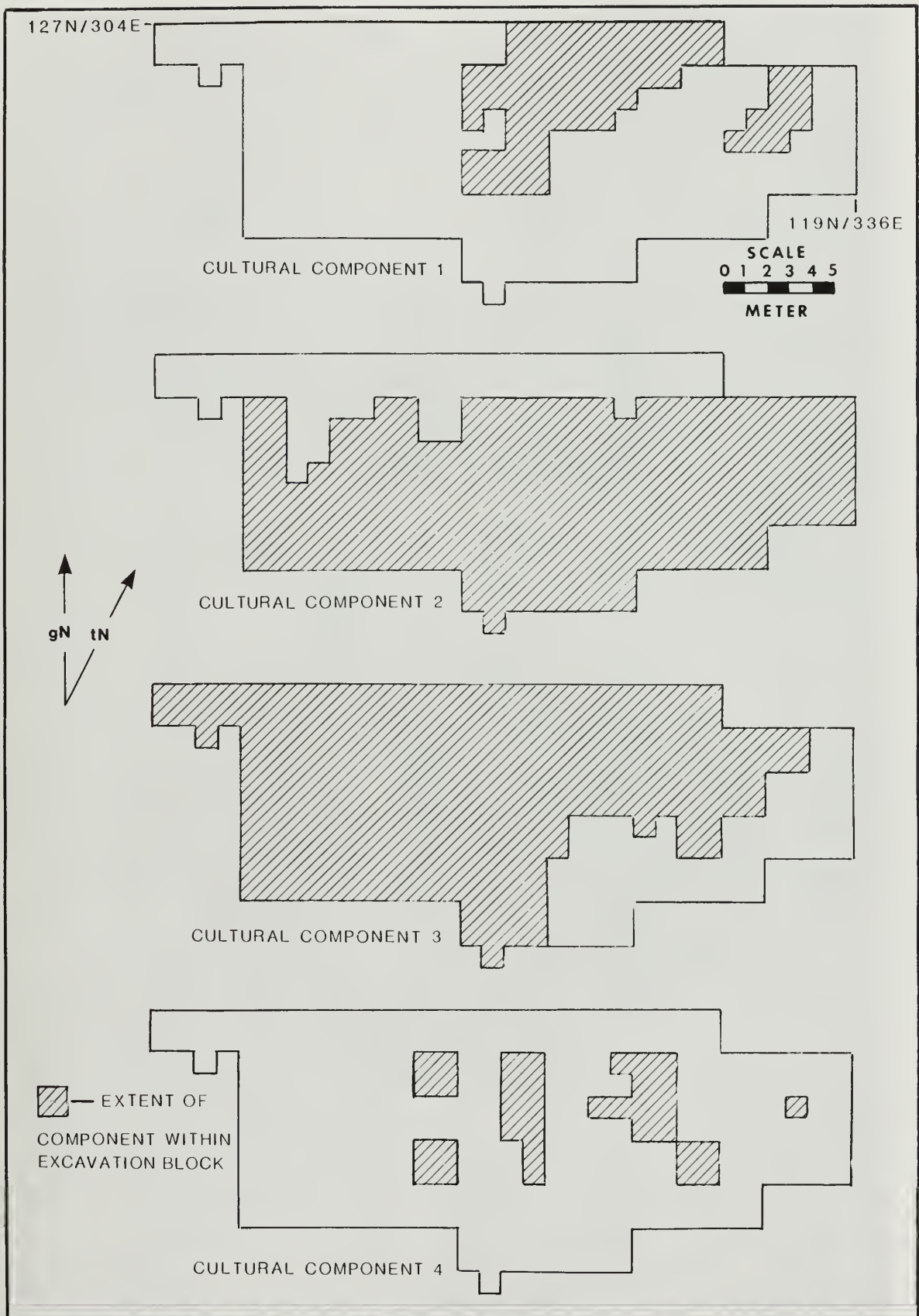


Figure 13. Illustration of the units from which the four cultural components were documented in the excavation block at the Buffalo Hump site.

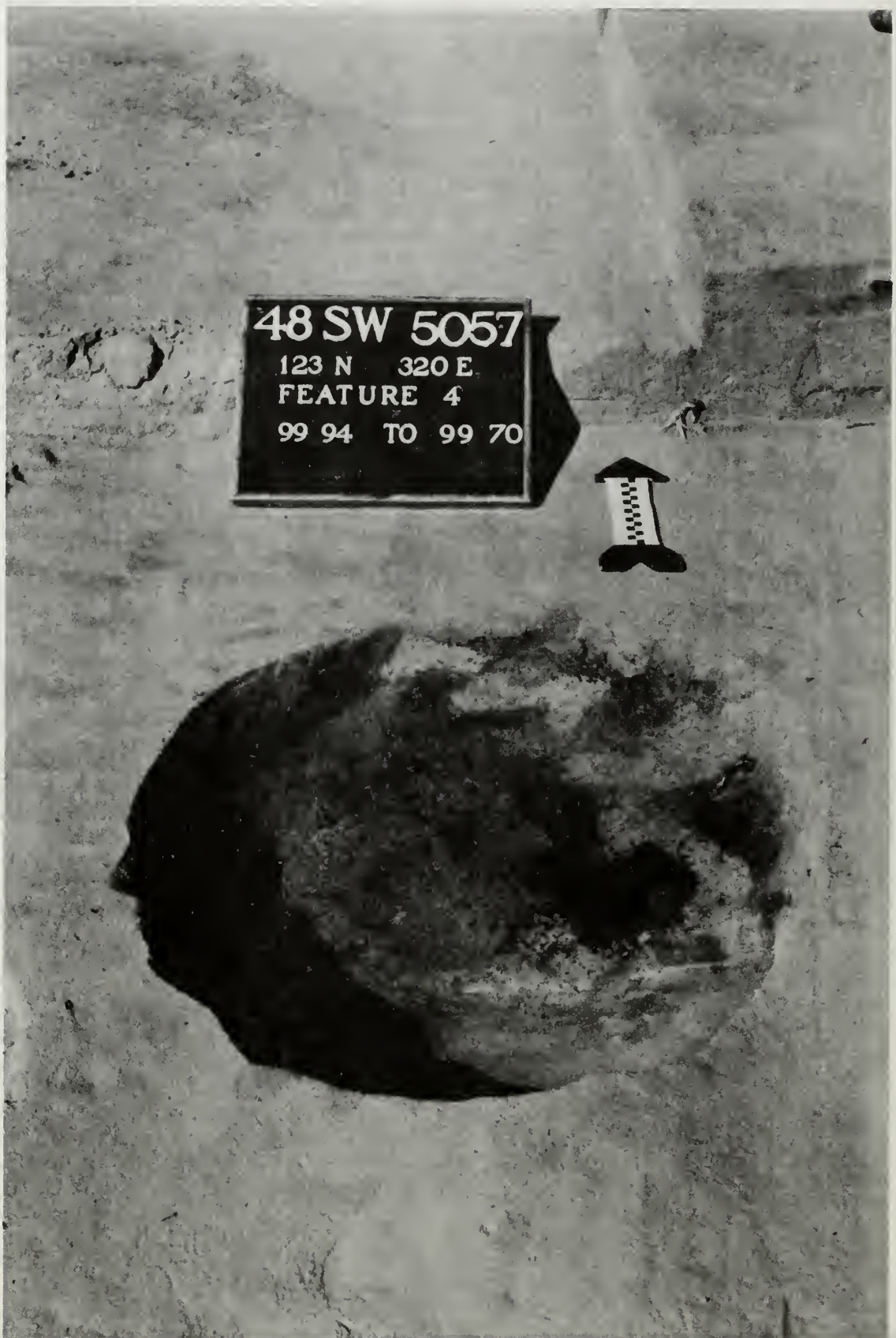


Figure 14. Post-excavation photograph of Feature 4, a large, oxidized, basin-shaped pit from Component 1 at the Buffalo Hump site (arrow points grid north).

(goosefoot and beeweed) recovered from the feature fill suggest that these and/or other portions of the plants were processed in this pit. Pollen from within the pit and from the living surface around the pit supports this interpretation of function. The presence of aggregates of *Cheno-am* in these pollen samples indicates that the reproductive parts of this plant were introduced directly into the feature or that the plant was growing nearby. Although no flakes, bone, or fired rock were recovered from within the pit, minor amounts of this cultural debris were documented from within a 5 m radius of Feature 4 (Figure 15).

The other feature from this component was recorded by PEC in the Frontier pipeline trench over 35 m west of Feature 4 (see Figure 3 in Appendix A). This Feature 1 was similar in size and shape to Feature 4, and had oxidation on its sides and bottom and no cultural debris from within or around it in the 1 m² excavated. It differed in that it had a single slab of tabular sandstone within it. The fill produced 22 charred goosefoot seeds, and pollen analysis corroborated this evidence with high frequencies of *Cheno-am* pollen as well as pollen from grass, beeweed, and sagebrush. On the basis of this evidence, this feature seems to have been used for a purpose similar to that of Feature 4. However, because sampling of the living surface around the feature was limited to a 1 m² unit, interpretations are limited as well.

Two other features (Features 7A and 7B) were recorded by PEC (Brechtel et al. 1984) in the north wall of the Frontier pipeline trench approximately 5 m northeast of Feature 4 (Figure 15). Although these features were not analyzed for radiocarbon age, they appear to be stratigraphically associated with Component 1. Feature 7A was a large, oxidized, bell-shaped pit with dimensional and morphological attributes consistent with the other features of the same type at the site. Feature 7B was located adjacent to Feature 7A, and it conformed with the typical characteristics of the small, unoxidized, basin-shaped pit feature type. The configuration and characteristics of these two features and the presence of artiodactyl bone from around them suggests they may represent a faunal processing area.

The limited evidence available in the features from Component 1 suggests that the site was occupied for a short time, primarily to process seeds and animal resources. The two widely spaced features (Feature 4 and PEC Feature 1) may represent two occupations or two processing areas. The paucity of associated cultural debris reflects the brevity of occupation but indicates involvement in a number of activities, including processing and consumption of plant and animal resources which produced debris in the form of lithic debitage, bone, charred seeds, and fired rock.

Material Culture

Lithic debitage is the only form of material culture from Component 1 (Table 2). The nine pieces of debitage represent four material types: metaquartzite and authigenic, biogenic, and oolitic chert. Most (78%) are from the terminal stages of reduction, the remainder are from intermediate stages. The majority (67%) are less than 2 cm in maximum dimension; the others are no greater than 4 cm. On the basis of the reduction stages and sizes represented in the lithic debitage, the flakes appear to have been produced primarily from tool use and maintenance rather than from tool production. The four material types

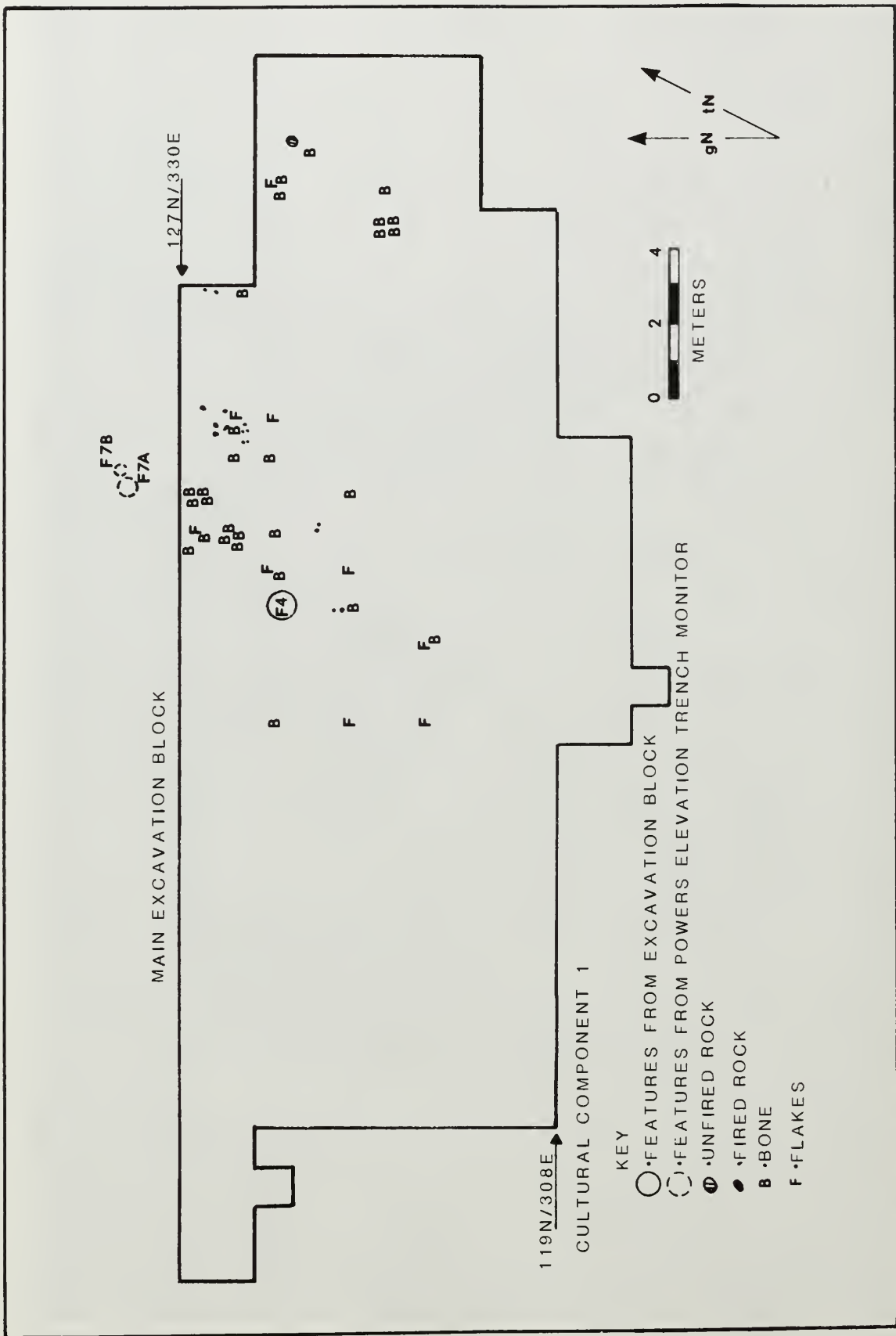


Figure 15. Plan map of the main excavation block showing the locations and types of all cultural remains recovered from Component 1 at the Buffalo Hump site. Features 7A and 7B, recorded by PEC, may be associated with this component.

Table 2. Summary of lithic debitage from Component 1 at the Buffalo Hump site.

Reduction Stage	Raw Material				Total
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Meta- quartzite	
Secondary flake fragment	1	1	-	-	2
Tertiary flake	2	-	1	-	3
Tertiary flake fragment	-	1	-	-	1
Tertiary microflake	1	-	-	1	2
Biface thinning flake	1	-	-	-	1
Total	5	2	1	1	9

probably reflect four different tools that were used and subsequently carried off the site or deposited in an area not sampled by the excavations.

Faunal Remains

A very small sample of faunal remains was recovered from Component 1. These are represented by 28 specimens of bone from pronghorn, unspecified artiodactyl, jackrabbit, and various unidentified taxa of similar sizes to the identified taxa (Table 3). All of the bone is represented by fragments of elements. More than half (57%) of the sample is less than 2 cm in maximum dimension, and the remainder is composed primarily of fragments of less than 6 cm in maximum dimensions. Only two (7%) of the specimens are burned.

The anatomical elements representative of pronghorn, artiodactyl, and medium to large and large mammals reflect primary exploitation of front and hind limbs with minor attention to the trunk represented by rib fragments. The jackrabbit elements indicate more complete use of the entire body. This evidence suggests that small game was brought to the site as a complete carcass whereas the larger game was transported in pieces, with the limbs the preferred portions. In the larger game animals, the long bones of the limbs contain the greatest concentrations of marrow and bone grease. The degree of fragmentation of the faunal remains, particularly in the large animals, reflects complete use of the represented portions of the carcass for extraction of marrow and bone grease or juice. The minor proportion of burned specimens supports this interpretation because extraction processes do not require that bone be exposed directly to heat. Most of the bone was scattered around the basin-shaped pit among fired rock, indicating the use of this pit for bone processing. The minor amounts of bone and rock may indicate this activity was not emphasized. However, the distribution of bone and rock appears to become more concentrated to the northeast of the pit feature in the area around Features 7A and 7B recorded by PEC in the Frontier pipeline trench. Nine long bone fragments from a medium-sized artiodactyl were recovered from around these features and may represent

Table 3. Summary of faunal remains recovered from Component 1 at the Buffalo Hump site.

Taxon	Number of Specimens	Total Weight	MNI
Pronghorn	1	1.8g	1
Artiodactyl	4	32.5g	-
Jackrabbit	4	1.9g	1
Large mammal	2	3.2g	-
Medium to large mammal	15	2.8g	-
Medium mammal	1	0.2g	-
Small to medium mammal	1	0.1g	-
Total	28	42.5	2

more of this activity area, some of which may still be intact to the north of the Frontier pipeline.

Plant Macrofossils

A total of 14 charred seeds was recovered from 11 liters of fill from Feature 4. These represent 16% of the total estimated volume of the pit. The majority (86%) of the seeds are identified as beeweed (*Cleome* sp.) and the remainder as goosefoot (*Chenopodium* sp.). Although this represents a relatively low density of seeds in the fill of the feature, the amount may reflect accidental fallout from seed processing activities that took place around the pit. Seed processing probably entailed roasting or parching of seeds to prepare them for storage or grinding into a meal. Roasting may have taken place in the pit although it is more likely that this process was conducted using shallow trays upon which the seeds were shaken among hot coals taken from the pit, as suggested in the ethnographic literature (Powell 1875:126-127). Such an activity may have resulted in the deposition of minor amounts of seeds into the adjacent fire pit. The types of seeds suggest a late summer or fall occupation.

Plant Microfossils

Pollen was recovered from one sample taken from the bottom of Feature 4 and from a sample located 40 cm north of the feature on the surface equivalent to the top of the feature. Both samples produced Cheno-am (*Chenopodiaceae* and *Amaranthaceae* families) pollen but with a higher frequency from the interior sample. Aggregates of Cheno-am pollen were also recorded from both samples. This evidence indicates that some plant in the Cheno-am families may have been processed in the feature or, at least, that this plant was growing in the immediate vicinity of the feature. Goosefoot seeds may have been parched in or near the pit prior to grinding them into flour, or the greens may have been cooked over the pit.

Summary

Component 1 was represented by one feature and its associated cultural debris, which combine to make up one multipurpose activity area

in the excavation block. Possibly associated with this activity area were two additional pit features from the Frontier pipeline trench which seem to represent faunal processing. The evidence from Feature 4 indicates that plant processing was conducted along with extraction of animal food sources. The activities must have required the use of flaked stone tools, which left debitage resulting from use and maintenance among the other debris. These remains may reflect a nuclear family hearth and the surrounding utilized space, a pattern which Yellen (1977:91) observed among the !Kung Bushmen in which multiple activities took place. The area around and between Feature 4 and PEC Features 7A and 7B seems to have been the locus of the most intensive activity. Another area in the eastern portion of the excavation block was utilized during this occupation. No features were found in association with this light scatter of bone and flakes, and the distribution of material suggests that the primary locus of activity was outside the excavation block to the north. Finally, a third activity area was apparent to the west of the excavation block in PEC Feature 1, which produced a radiocarbon estimation equivalent to that of Feature 4. Based on the evidence from within this feature, this area may have been used to process plants. However, data recovery was restricted to within 50 cm of the feature, and it is possible that more and different evidence may be present in a larger area around the pit.

Component 2

The Component 2 occupation occurred about 400 years after Component 1, at around 1400 years ago during the early part of the Late Prehistoric period. Cultural remains were well represented and occurred in patterned distributions across the southern three quarters of the excavation block. The evidence in the cultural remains indicates a habitation camp occupied for a period of time during late summer and fall by a small group of hunters and gatherers, probably represented by two to three nuclear families.

In the following descriptions of the cultural remains, attributes and associations are described and quantified. General interpretations are offered in summary form as a means of relaying the descriptive data. In Chapter 5, these interpretations are developed more fully through detailed examination of the data.

Features

Twenty features representing five types were documented from this component (Figure 16). The features and associated cultural remains were spatially distributed into three large groups, or concentrations. These concentrations were designated as Activity Areas A, B, and C for convenience in referencing and for detailed functional analysis in Chapter 5. Two of the activity areas (A and B) were composed of pit structures and their associated interior and exterior features. The pit structures are considered to be the remains of housepits over which were constructed domed or conical shelters made of locally available bushes, such as sagebrush. The third activity area (C) is interpreted as an exterior area composed of a small basin pit and its associated cultural debris.

Activity Area A was situated between the two others and was composed of 12 features: a centrally located pit structure (Feature 16)



Figure 16. Plan map of the main excavation block showing the three activity areas and the locations and types of cultural remains recovered from Component 2 at the Buffalo Hump site (illustrates all artifacts and fired rock documented from in situ contexts with artifacts from screened 1 x 1 m lots plotted in the center of the unit from which they were recovered).

with four interior and seven exterior features (Figure 16). This pit structure (Figures 17 and 18) was the best example of this type of feature at the Buffalo Hump site because of its excellent definition and integrity. A large, oxidized, bell-shaped pit, Feature 23 (Figure 19), was situated on the southern edge of the pit structure (Feature 16), and another feature of the same type, Feature 24 (Figure 20), was located in the center of the structure. Two smaller pits were located in the western portion of the structure's floor: a small, unoxidized, bell-shaped pit (Feature 33) and a small, unoxidized, basin-shaped pit (Feature 25). A midden concentration (Feature 15) was situated outside and adjacent to the southeastern edge of the pit structure. Also exterior to the structure and located 1 m from its edges were two unoxidized basins: a medium-sized one (Feature 26) to the north and a small one (Feature 21) to the east. Farther removed from the structure, 2 m to the southwest, was a group of four basin features (Figure 21) which may be viewed as another use area within the primary Activity Area A. This group was composed of a small, oxidized, basin-shaped pit (Feature 37); a medium, unoxidized, basin-shaped pit (Feature 36); and two irregular, shallow basins, one small (Feature 38) and one medium (Feature 39). This group of features was included in Activity Area A because it appeared to represent a processing area exterior to, but still associated with, the pit structure.

Activity Area B was located to the east of Area A and was composed of seven features. Here a pit structure, Feature 27 (Figures 22 and 23), was located in the northern portion of the area with one wall feature and associated exterior features situated within a 2 m radius of the southern one half of its edge. Although the pit structure contained no interior features dug into the floor, a medium, oxidized, basin-shaped pit (Feature 14) was located in its eastern wall. Three other features were situated within 1.5 m of the southwestern edge of the structure: a medium, oxidized, basin-shaped pit (Feature 7); a small, unoxidized, bell-shaped pit (Feature 3); and a small, fired rock concentration (Feature 1). A large midden and rock concentration (Features 22 and 11) was located 2 m south of the pit structure.

Activity Area C was located in the western portion of the excavation block to the west of Activity Area A (see Figure 16). It was composed of one small, unoxidized, basin-shaped pit (Feature 34) and the cultural debris concentrated around this feature. No evidence of a pit structure was documented in this activity area. However, a 2 m diameter void, located about 2 m north of the basin-shaped pit, was apparent within the concentration of cultural material and fired rock. This circular empty space was of similar dimension to the pit structures, and its spatial relation to Feature 34 resembled the pattern seen in Activity Area A: the pit structure and group of four features to the south. Although Activity Area C is considered to be a locus external to structures because of negative evidence for a pit structure, there is a possibility that a surficial structure may have been present, leaving a void in the cultural debris. This possibility will be examined in Chapter 5.

Material Culture

The artifact assemblage from Component 2 consists of a small sample of flaked lithic tools and debitage, a number of fragments of ground-stone, a fairly large amount of modified bone, and a bead made from a

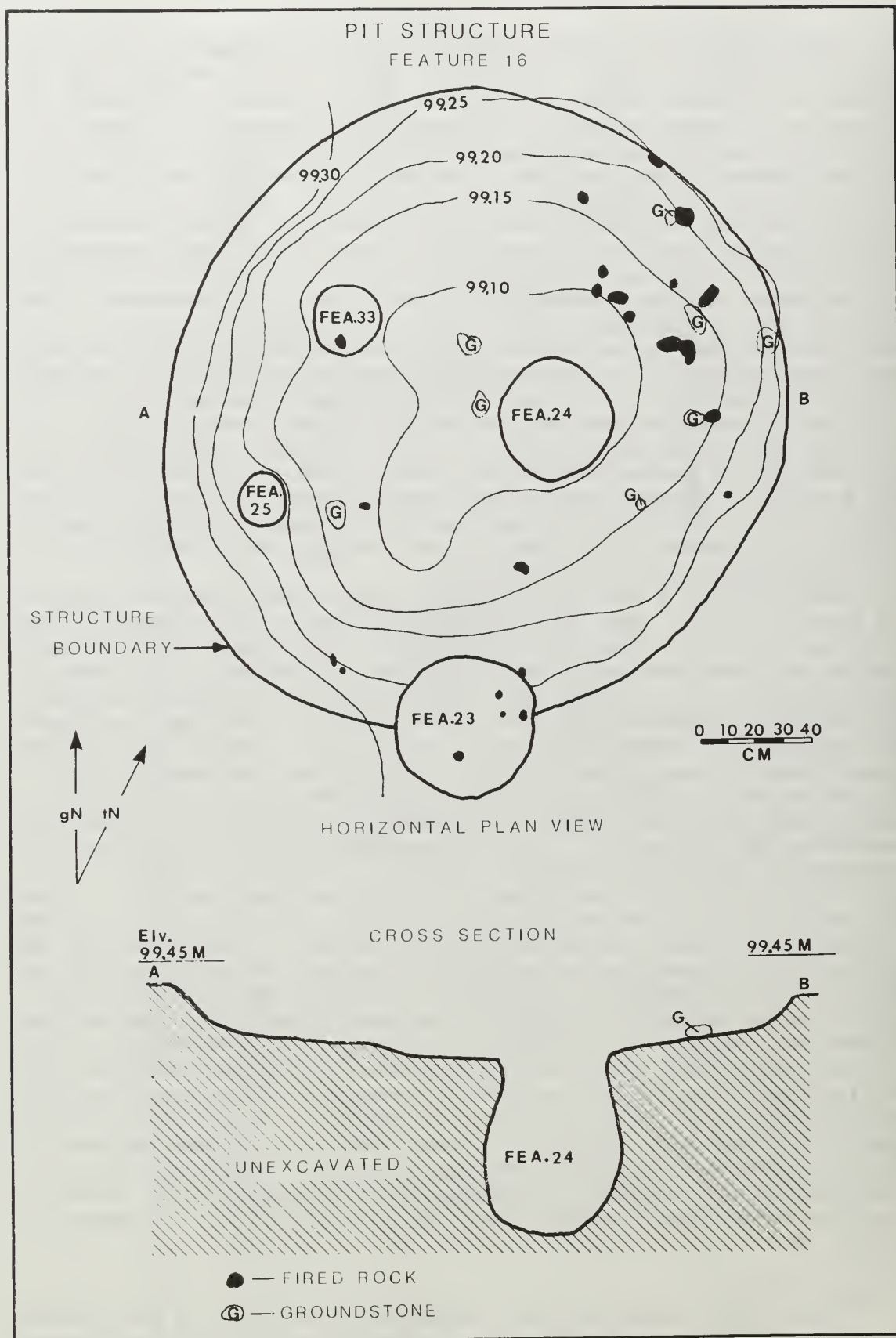


Figure 17. Graphic illustration of the plan view and cross section of a pit structure (Feature 16) from Activity Area A in Component 2 at the Buffalo Hump site.



Figure 18. Post-excavation photograph of a pit structure (Feature 16) from Activity Area A in Component 2 at the Buffalo Hump site (arrow points grid north).



Figure 19. Post-excavation photograph of a large, oxidized, bell-shaped pit (Feature 23) located on the southern edge of a pit structure (Feature 16) from Activity Area A in Component 2 at the Buffalo Hump site (view looking grid south).

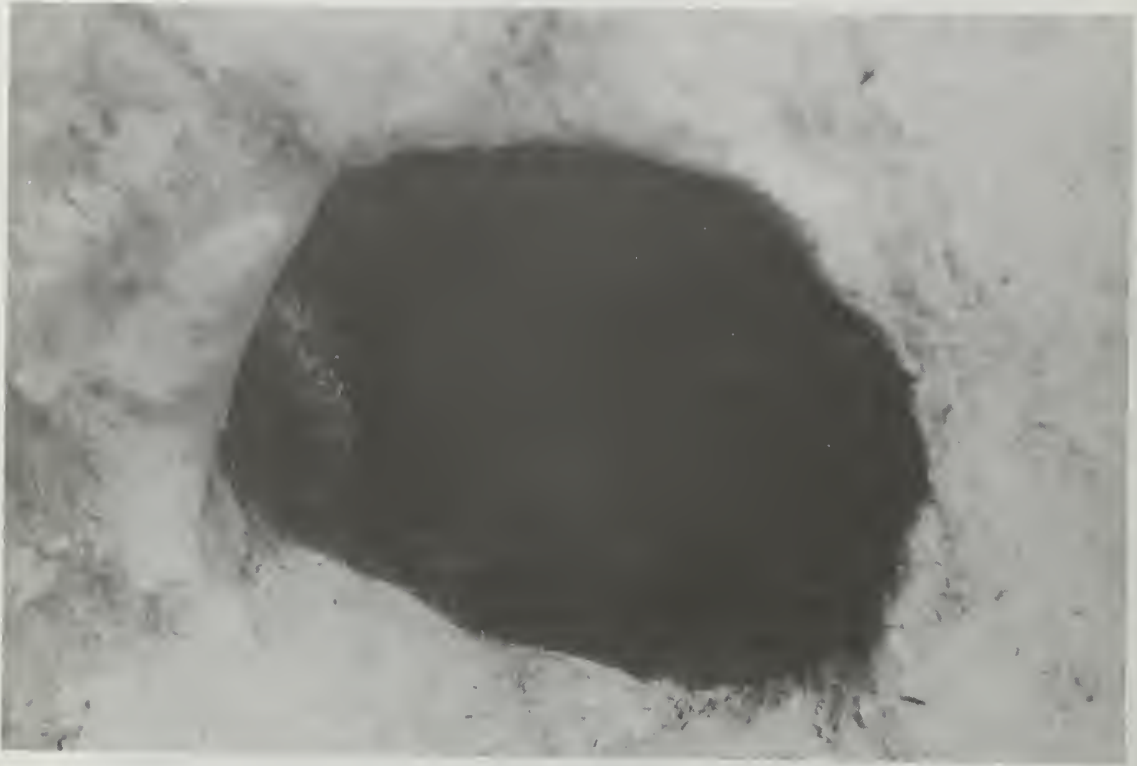


Figure 20. Post-excavation photograph of a large, oxidized, bell-shaped pit (Feature 24) located in the center of a pit structure (Feature 16) from Activity Area A in Component 2 at the Buffalo Hump site (view looking grid east).



Figure 21. Pre-excavation photograph of the exposed upper outlines of four features (Features 36, 37, 38, and 39) located 2 m southwest of a pit structure (Feature 16) from Activity Area A in Component 2 at the Buffalo Hump site (arrow points grid north).

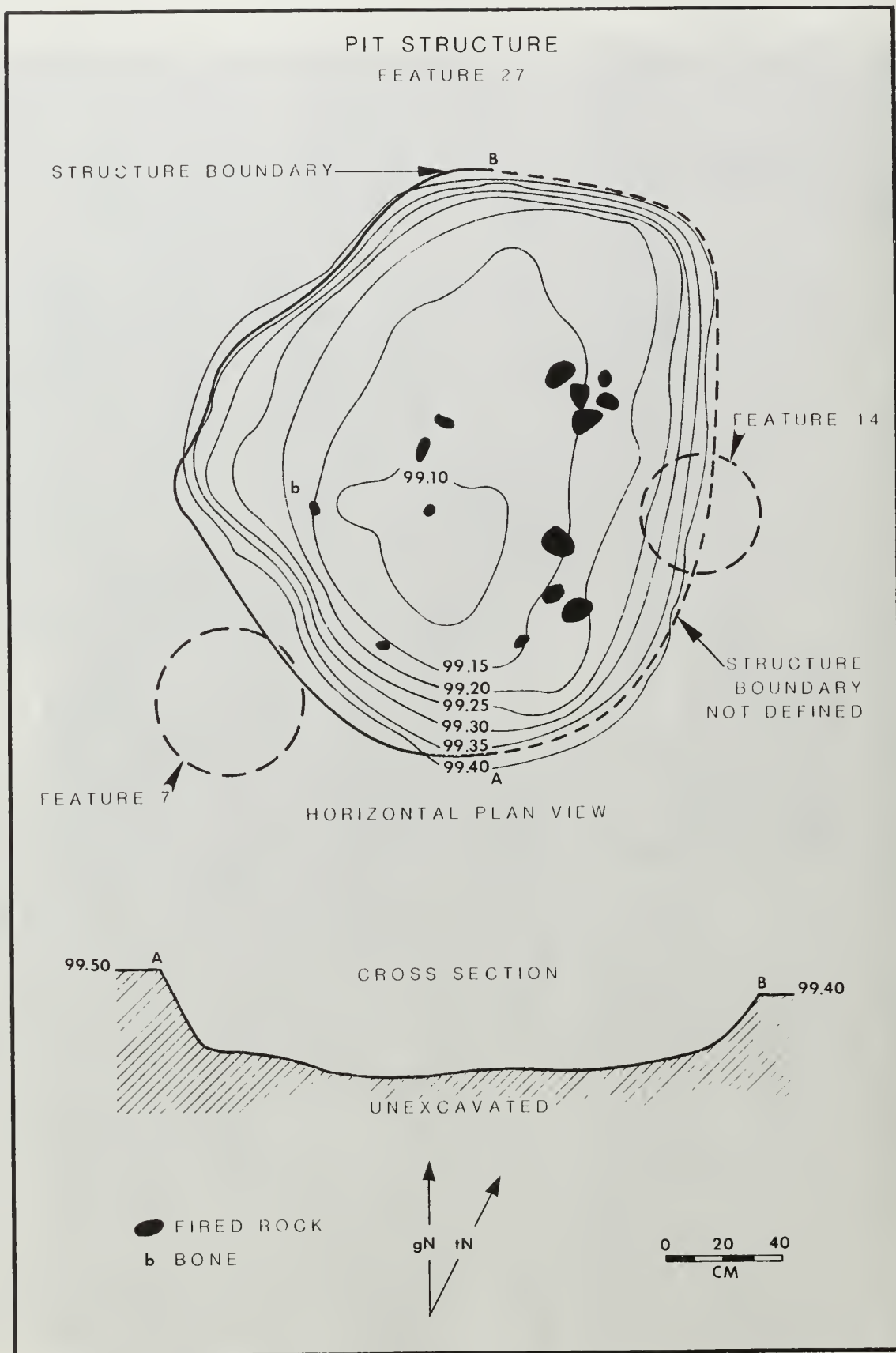


Figure 22. Graphic illustration of the plan view and cross section of a pit structure (Feature 27) from Activity Area B in Component 2 at the Buffalo Hump site.



Figure 23. Post-excavation photograph of a pit structure (Feature 27) from Activity Area B in Component 2 at the Buffalo Hump site (arrow points grid north).

juniper seed. Each of these minor classes of artifacts was recovered from each of the three activity areas in variable amounts.

Flaked Lithic Artifacts

Flaked lithic artifacts are represented by 6 projectile points and fragments, 1 drill fragment, 1 biface blank, 1 biface preblank, 2 retouched flakes, 1 utilized flake (Table 4), and 323 pieces of lithic debitage. A detailed analysis of these artifacts is presented in Appendix B.

The small sample of tools is represented by seven finished and two unfinished formal tools and three expedient tools. The most common raw material from which these tools are made is algalitic or biogenic chert, and authigenic and oolitic chert, dendritic opal, and chalcedony represented. Many (58%) of the recovered tools are fragments; some are complete or nearly complete. Tools were recovered from each of the activity areas (see Figure 16).

Projectile points comprise one-half of all the tools. Two defined types of points are represented. Two specimens are identified as Type II (Figure 24a, b), which bears close resemblance to the Rose Spring type dating to the early part of the Late Prehistoric period in the Great Basin (Holmer 1986) and portions of Wyoming (Smith 1987c). Type II projectile points were recovered from Activity Areas B and C; the one from Activity Area B is the only complete specimen of this type. One base fragment of a Type III projectile point was recovered from Activity Area C (Figure 24c). This type roughly resembles Rose Spring points, but it is distinguished as a separate type because of the greater width of the notches and the more oval outline of the blade. The other three projectile points are Type IV (indeterminate). Two of these specimens are fragments of bases (Figure 24d, e) from Activity Areas B and C. The third is a nearly complete specimen recovered from outside the excavation block and stratigraphically associated with this component. This specimen (Figure 24f) appears to have been a corner-notched point from which the tangs were broken; subsequently, a shallow side notch was fashioned on one side only before the artifact was discarded. Generally, the types of projectile points from Component 2 are consistent with the radiocarbon age of the component and indicate affiliations with Great Basin cultures in their similarities to the Rose Spring type.

The drill (Figure 24g) was recovered as a base fragment from near the group of four features that compose a use area exterior to the pit structure in Activity Area A. The drill element appears to have been broken off at its base, leaving the basal portion of the tool. This specimen may actually represent an unfinished tool discarded as a manufacturing failure, although the absence of the working end makes it impossible to tell at what stage it was discarded.

The unfinished tools are from Activity Areas A and B. The preblank (Figure 24h) from Activity Area B is a pebble of authigenic chert that was bifacially flaked on two edges before being discarded. The blank (Figure 24i) is a lateral fragment from a crudely flaked biface.

The expedient tools are retouched and utilized flakes from Activity Areas A and C. One of the retouched flakes (Figure 24j) was recovered as two fragments, 9 m apart, from Activity Area A; one lateral side was bifacially modified to form a sharp edge. The other retouched flake (Figure 24k) from Activity Area C is a blade that shows use-wear on both

Table 4. Summary of flaked lithic tools from Component 2 at the Buffalo Hump site.

Tool Class/Type	Raw Material					Total
	Authigenic Chert	Algalitic Chert	Oolitic Chert	Chalcedony	Dendritic Opal	
Projectile Point						
Type II	-	2	-	-	-	2
Type III	-	1	-	-	-	1
Type IV	-	1	1	1	-	3
(Indeterminate)						
Drill	1	-	-	-	-	1
Blank	-	1	-	-	-	1
Preblank	1	-	-	-	-	1
Retouched flake	1	-	-	-	1	2
Utilized flake	-	-	-	-	1	1
Total	3	5	1	1	2	12

lateral edges. One of the edges has a shallow notch with wear indicative of its use as a "spokeshave." The type of unifacial modification and wear on the other edge suggests its use for scraping rather than cutting. The utilized flake (Figure 241) from Activity Area C is actually a fragment of a tool that appears to have been used for cutting or sawing.

The debitage from Component 2 is represented by 323 flakes from all stages of the reduction sequence (Table 5). Of the five represented material types, authigenic chert is dominant (54%), biogenic chert is the second most frequent (32%). The biogenic cherts are composed of algalitic, stromatolitic, and fossiliferous, all of which can be found in the immediate vicinity of the site. This is also the case for the other four raw materials. Generally these raw materials occur in the area as fairly small pebbles and cobbles. The raw materials represented in the debitage are compatible with those seen in the tools.

The technological stages represented in the debitage reflect the full spectrum of the reduction sequence. All primary flakes comprise 7% of the total, secondary flakes make up 33%, and tertiary flakes represent 53%, biface thinning flakes 2%, and other types 5%. Within each of the three major technological types, micro- and sub-microflakes are represented in similarly significant proportions: 38% of the primary flakes, 40% of the secondary flakes, 49% of the tertiary flakes, and 42% of the total debitage. These high frequencies of small debitage in the total sample as well as in each technological stage may be a reflection of the small size of the raw source material, particularly in the case of the primary and secondary stages. The small proportions of biface thinning flakes and submicroflakes (2% and 5%,



Figure 24. All flaked lithic tools recovered from Component 2 at the Buffalo Hump site: Type II (Rose Spring) projectile points (a, b); Type III (Indeterminate corner-notched) projectile point (c); Type IV (Indeterminate) projectile points (d - f); drill base fragment (g); biface preblank (h); biface blank fragment (i); retouched flakes (j, k); and utilized flake (l).

Table 5. Summary of lithic debitage from Component 2 at the Buffalo Hump site.

Reduction Stage	Raw Material					Total	Percent of Total	Percent of total by technological type
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Dendritic Opal	Meta-quartzite			
Primary flakes	3	4	-	2	-	9	3%	
Primary microflakes	9	-	-	-	-	9	3%	8%
Primary flake fragment	3	1	1	1	-	6	2%	
Secondary flake	26	16	4	2	1	49	15%	
Secondary microflake	25	11	1	4	-	41	13%	33%
Secondary submicroflakes	2	-	-	-	-	2	1%	
Secondary flake fragments	4	7	2	-	-	13	4%	
Tertiary flake	24	26	7	1	2	60	18%	
Tertiary microflake	41	20	1	10	-	72	22%	
Tertiary submicroflake	10	1	-	2	-	13	4%	52%
Tertiary flake fragment	14	8	2	4	-	28	8%	
Biface thinning flake	4	1	-	1	-	6	2%	2%
Shatter/Chunk	6	7	-	-	-	13	4%	4%
Tested material	1	1	-	-	-	2	1%	1%
Total	172	103	18	27	3	323	100%	100%
Percent of Total	54%	32%	5%	8%	1%	100%		

respectively) suggest that the terminal stages of tool production and subsequent tool maintenance were not commonly practiced. However, the minor proportion of submicroflakes may be a result of the sampling technique in which $\frac{1}{4}$ inch mesh was used to sieve most of the excavated matrix. Generally, this evidence indicates that during this occupation, tool manufacturing was conducted to a limited extent, using raw materials available in the immediate vicinity. The presence of a preblank and blank lends support to this interpretation. The overall small size of the sample of tools and debitage, however, suggests that manufacturing of flaked lithic tools was not a primary focus of activity during this occupation of the site.

Spatially, the debitage was distributed fairly evenly over the excavation block in very minor amounts. The greatest concentration of debitage was recovered from Activity Area C. This spatial distribution will be examined in greater detail in Chapter 5 when the activity areas are scrutinized for patterns of spatial relationships.

Groundstone

Most (71%) of the groundstone recovered at the site is from Component 2. All of the 27 specimens are fragments of artifacts and, with the exception of one shaped mano fragment of orthoquartzite, all are pieces of sandstone slabs. A few of these slab fragments fit together to form larger fragments, but none compose a piece large enough to determine the original shape of a grinding slab. All of these sandstone slab fragments appear to have been acquired from outcrops in and around the site, and this material is fairly friable and easily broken into tabular pieces. This fact and the fact that the majority (77%) of the ground sandstone slab fragments are burned may account for our inability to fit them together into the original form. Many minute fragments may have exfoliated due to burning, which would leave the larger fragments that cannot be pieced together.

Groundstone artifacts were represented in all three activity areas (see Figure 16). Only one slab fragment was recovered from Activity Area B, from within a rock concentration (Feature 11). In Activity Area C, the quartzite mano fragment and four slab fragments were recovered from near the basin-shaped pit (Feature 34). The remainder (78%) was found in Activity Area A from within and around the pit structure (Feature 16). Eight of these slab fragments were found on the floor of the pit structure and two others were recovered from within the central, bell-shaped pit (Feature 24). Six other slab fragments were found within 1 m of the edge of the pit structure, and the others were distributed around it within 3 m of its edges. A pollen wash from one of the slab fragments from the floor of the pit structure produced a large value of grass pollen as well as an abundance of Cheno-am aggregates, which were also present in a pollen sample taken from the structure floor 60 cm west of the groundstone fragment.

The evidence in the pollen record and the extremely large amounts of charred seeds recovered from within the pit structure and its interior features, combined with the large amounts of groundstone in close association, indicate that processing of plant resources was a primary emphasis during this occupation. The principal locus of this activity appears to have been within the pit structure in Activity Area A with a secondary locality in Activity Area C around the basin-shaped pit, based on the presence of groundstone in this area.

Modified Bone

A total of 15 specimens of modified bone (Table 6) was recovered from Component 2. These represent three types: three awls; four tubes, or beads; and eight discards from tube manufacture (Figure 25). Most (87%) of the modified bone was made from elements of jackrabbit and small mammals; the remainder are from pronghorn and medium to large mammal. Two of the tubes are fragmentary, but the remainder of the modified bone artifacts appear to have been recovered in their original, complete condition. With the exception of one of the tubes and one of the tube discards, all of these artifacts are unburned.

Table 6. Summary of types of modified bone from Component 2 at the Buffalo Hump site.

Animal Element Portion	Type			Figure	Total
	Awl	Tube	Tube Discard		
Pronghorn					
Metatarsal					
Proximal, anterior shaft	1	-	-	25a	1
Medium to large mammal					
Long bone					
Shaft	1	-	-	25b	1
Jackrabbit					
Femur					
Distal shaft	-	-	1	25j	1
Tibia					
Middle shaft	1	-	-	25c	1
Proximal shaft	-	-	3	25k-m	3
Distal end	-	-	2	25g, i	2
Metatarsal					
Proximal end	-	-	2	25f, h	2
Metapodial					
Middle shaft	-	1	-	25d	1
Small mammal					
Long bone					
Shaft	-	3	-	25e	3
Total	3	4	8		15

The three awls (Figure 25a-c) are made from fragments of bone in which the fracture patterns created pointed forms that were further modified for, or by, use. These are expedient tools in the sense that they do not appear to have been derived through intentional manufacture but were produced as a result of exploitation of the fortuitous forms, probably found in the waste from food processing. In contrast, the bone tubes (Figure 25d, e) were made through a sequence of predetermined steps, leaving the residue (Figure 25f-m) from their manufacture through which to trace these steps. For bone tubes, the artificer must have chosen a bone or fragment of appropriate size and shape out of the faunal remains (from food processing), and, using a sharp-edged stone implement, cut the tube by incising grooves around the circumference of bone to facilitate controlled breakage. Once the tube was cut and snapped, its ends were smoothed and polished and the remainder of source bone discarded without further modification.

Although modified bone artifacts were recovered from all three activity areas, the majority (73%) were found in Activity Area B. Most (88%) of the tube discards came from this area. One finished, complete tube and the pronghorn awl came from within about 1 m of the small, basin pit in Activity Area C (see Figure 16). An awl made from the long bone shaft of a medium to large mammal was found in the pit structure in Activity Area A, and a tube discard came from near the structure's edge.

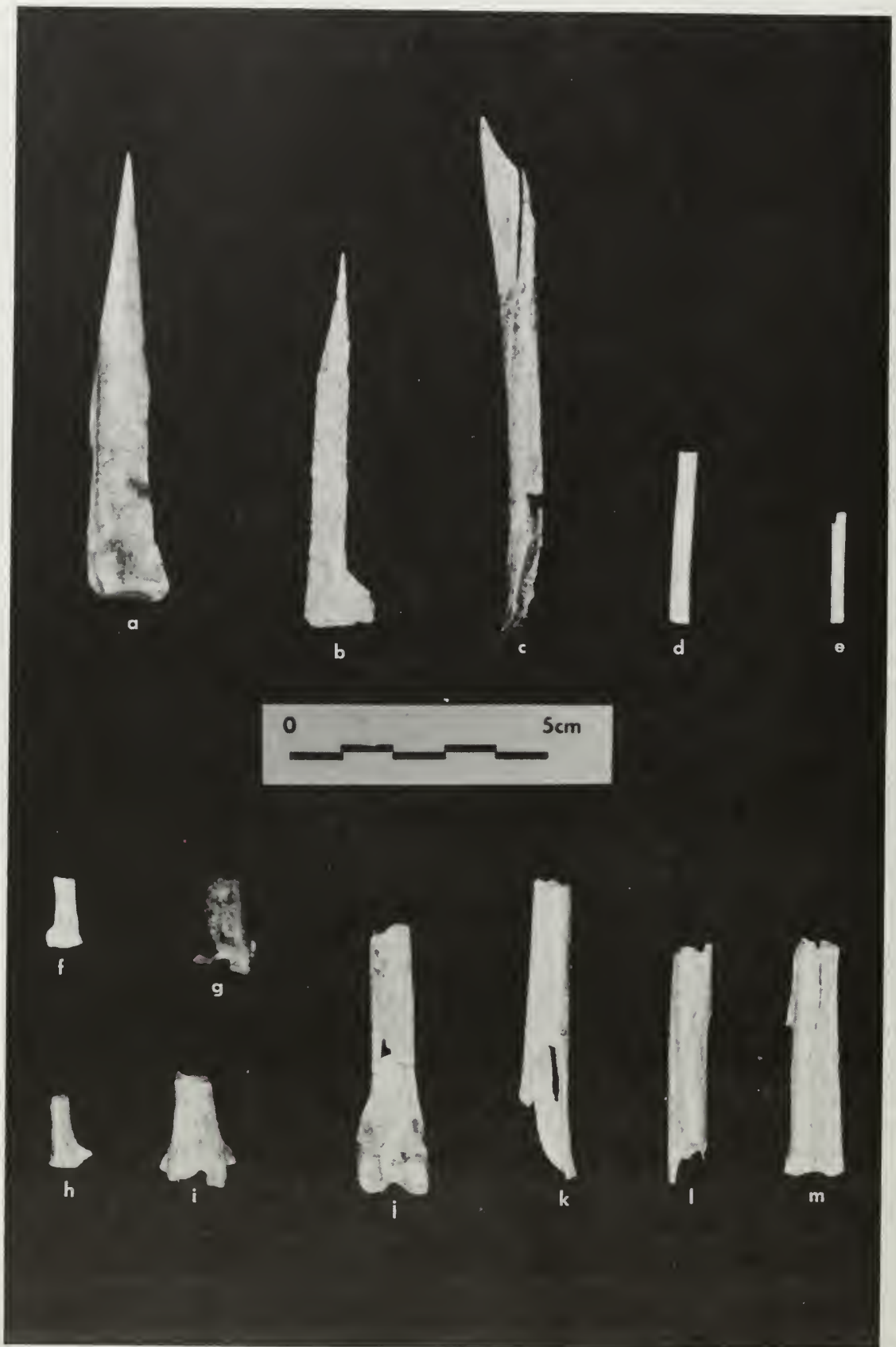


Figure 25. Modified bone artifacts recovered from Component 2 at the Buffalo Hump site: awls (a-c); finished tubes (d, e); and tube discards (f-m).

Of the remainder in Activity Area B, an awl, two tubes, and a tube discard were recovered from within the midden concentration (Features 11 and 22). One tube discard came from 1 m east of this midden, and one tube was found within a rock concentration (Feature 1). The remainder of the tube discards were scattered to the east of the pit structure (Feature 27) in Activity Area B.

Juniper Seed Bead

One modified seed (Figure 26) of Utah juniper was recovered from the fill of a basin-shaped pit (Feature 36) in Activity Area A. It was made by removing both ends of the seed to expose the naturally hollow center and then briefly abrading an end to produce a smooth, uniform, rounded hole. The remainder of the body of the seed is unmodified. It is unusual in the archaeological record from this area. Only one other site (Truesdale 1984) has recorded such specimens. It yielded over 1000 such specimens from a burial of Late Prehistoric age. Because junipers are not presently found within a considerable distance of Buffalo Hump, its presence here indicates that it was obtained, and probably made, some distance from the site. Presently, Utah junipers occur in stands on the upper margins of the Great Divide Basin. The occupants of the site probably acquired the seed in the course of their yearly rounds in and out of the basin.

Faunal Remains

A total of 708 faunal specimens weighing 480.8 g was recovered from Component 2 (Table 7). Although other recent, intrusive bones were also collected, this total includes only the faunal remains that are considered to be archaeological because of their characteristics. These characteristics are described in Appendix C. Although this is a relatively small sample, it reflects some interesting aspects of the subsistence base at the time of this occupation.

The remains from Component 2 represent the widest variety of exploited animals of all the components at Buffalo Hump. Eight specific taxa are identified, and five general taxa that probably represent parts of the former: bison, pronghorn, coyote/dog, bobcat, badger, jack-rabbit, rodent, bird, artiodactyl and large, medium to large, medium, and small to medium mammals. Although the more specifically identified taxa are represented by relatively small numbers, consideration of the analogous sizes of nonspecific mammals helps to augment the data. In the most general sense, artiodactyls and large and medium to large mammals are equivalent to bison and pronghorn, medium mammals to coyote, bobcat, and badger, and small to medium mammals to jackrabbit, rodent, and bird. Obviously there is some degree of unquantifiable overlap on both sides of the medium mammal category, and the smallest sized "mammals" should more accurately be designated as "animals." With such a breakdown, three general types of animals appear to have been exploited: large game ungulates, medium-sized fur bearers or carnivores, and small game. The combined numbers and weights of the large animals represent the largest proportion (89% by number and 88% by weight) of the faunal specimens with minor frequencies of the other two types. Considered by themselves, these proportions indicate that large game was emphasized in the subsistence base. However, attention to other attributes of the faunal remains points out subtleties that are not apparent in these gross tabulations.

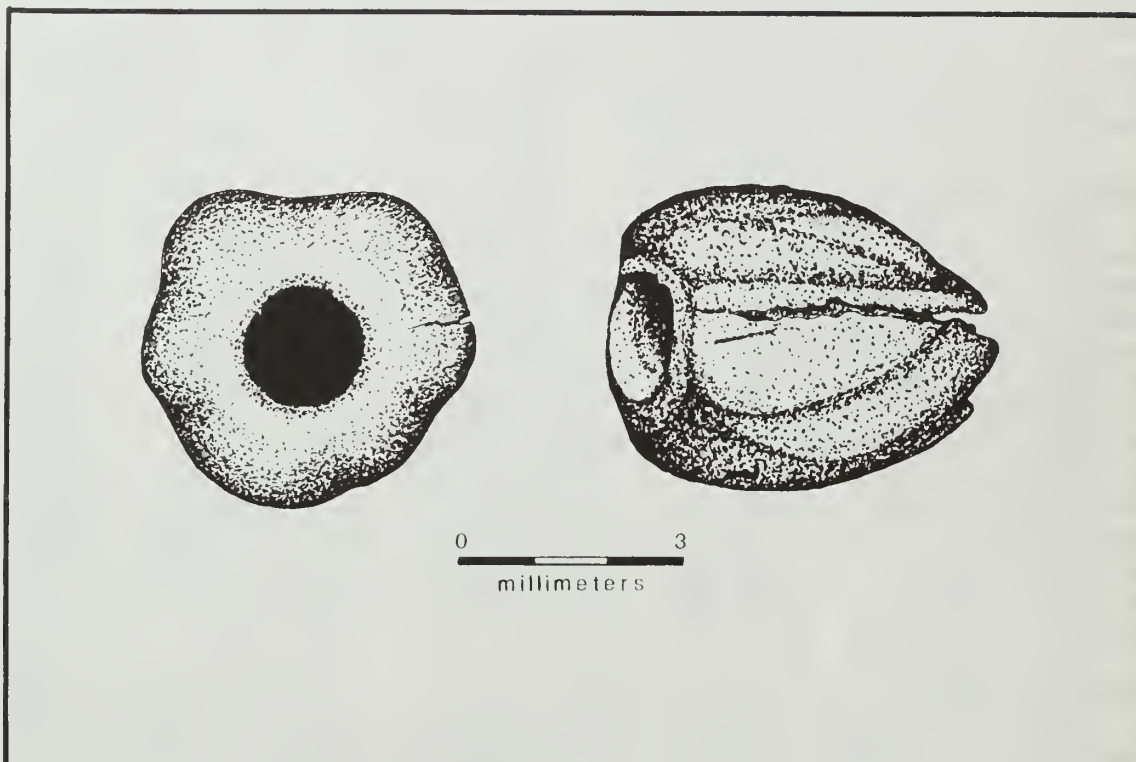


Figure 26. Enlarged illustration of the juniper seed bead recovered from Component 2 at the Buffalo Hump site.

Table 7. Summary of faunal remains recovered from Component 2 at the Buffalo Hump site.

Taxon	Number of Specimens	Total Weight	MNI
Bison	5	14.0 g	1
Pronghorn	1	0.5 g	1
Artiodactyl	6	25.4 g	-
Coyote/dog	1	0.8 g	1
Bobcat	8	8.1 g	1
Badger	10	25.6 g	1
Jackrabbit	31	19.0 g	2
Rodent	1	*	1
Bird	1	0.1 g	1
Large mammal	306	320.9 g	-
Medium to large mammal	309	62.7 g	-
Medium mammal	9	1.6 g	-
Small to medium mammal	20	2.1 g	-
Total	703	480.8 g	9

*less than 0.1 g

An outstanding attribute of the sample is the great degree of fragmentation of the bones; 87% of the entire number are represented by fragments of less than 3 cm in maximum dimension. In fact, only 21 specimens (3%) are complete elements, and most (76%) of these are the small, compact bones of the distal extremities of the limbs. The great degree of fragmentation partially accounts for the high proportion of specimens from large animals because their larger bones, when broken, are more likely to produce greater numbers of small fragments than the smaller animals. Also, the bones of larger animals, particularly the long bones of artiodactyls, are more likely to be broken down for extraction of marrow and bone juice and grease because they contain greater concentrations of these nutrients in relation to the energy required to extract them than the bones of small animals. Most (81%) of the combined number representing all large animals are identified as long bone shaft fragments from the nonspecific larger animals. In addition, the elements of the limbs and their distal extremities are represented primarily in the identified artiodactyls and carnivores, whereas the jackrabbits are represented by more of the entire body.

Generally, the evidence in the faunal remains from Component 2 suggests the following conclusions:

1. Large game ungulates (bison and pronghorn) were emphasized in the subsistence base for the high concentrations of nutrients in their limbs, which were selectively transported to the site and processed intensively for extraction of marrow and bone juice and grease;
2. Small animals, such as jackrabbits, were procured and brought to the site as whole carcasses to supplement the diet (and provide raw material for tubes, or beads); and
3. Carnivores may have been exploited and brought to the site as pelts, which retained the bones of the distal extremities, or were killed as fortuitous encounters or for extermination of a potential nuisance on the site.

Plant Macrofossils

A total of 9162 charred seeds was recovered from 15 of the 17 sampled features in Component 2 (Table 8). The majority (73%) of seeds are from goosefoot (Chenopodium sp.) plants, with mustard (Cruciferae family), povertyweed (Monolepis nuttalliana), saltbush (Atriplex sp.) sedge (Carex sp.), grass (Gramineae family), sagebrush (Artemisia sp.), sunflower (Helianthus sp.), beeweed (Cleome sp.), Indian ricegrass (Oryzopsis hymenoides), phacelia (Phacelia ivesiana), and unknown taxa also represented (listed in order of greatest frequency). The majority (96%) of charred seeds were recovered from within the pit structures and their interior features. Most (73%) of these are goosefoot seeds, representing 95% of the total goosefoot seeds from all features in this component. Slightly more than two-thirds (68%) of all seeds from all features came from the large, bell-shaped pit (Feature 24) in the center of a pit structure (Feature 16). The features external to the pit structures not only produced fewer seeds, but most yielded more seeds from plants other than goosefoot. This evidence indicates that the pit structures may have been specialized shelters which served as loci for

Table 8. Summary of plant macrofossils recovered from Component 2 at the Buffalo Hump site.

Feature Number	Volume of Sample	Number of Charred Seeds	Plant Taxa (in order of greatest frequencies)
7	10.0 liter (44%*)	8	Goosefoot
14	5.0 liter (44%)	87	Goosefoot, sedge, grass, unknown
15	5.0 liter (26%)	84	Goosefoot, sunflower, beeweed
16	15.0 liter (1%)	1249	Goosefoot, povertyweed, mustard, sedge, sunflower, grass
21	5.0 liter (88%)	183	Goosefoot, povertyweed, mustard, unknown, sunflower, grass
23	20.0 liter (32%)	16	Goosefoot, sedge, unknown
24	17.5 liter (24%)	6214	Goosefoot, mustard, povertyweed, saltbush, sedge, grass, sagebrush, unknown
25	2.5 liter (100%)	324	Goosefoot, povertyweed, saltbush, sedge
26	4.5 liter (32%)	12	Beeweed, goosefoot
27	3.0 liter (+)	348	Goosefoot, povertyweed, mustard, sunflower, saltbush
33	5.0 liter (86%)	597	Goosefoot, povertyweed, mustard, sedge, saltbush, sagebrush
34	4.0 liter (100%)	8	Grass, Indian ricegrass, phacelia
36	7.5 liter (51%)	15	Sagebrush, Indian ricegrass, beeweed, grass, goosefoot, phacelia
37	4.0 liter (100%)	15	Phacelia, Indian ricegrass, goosefoot, grass
38	2.0 liter (87%)	2	Unknown
Total seeds		9162	

*percent of total feature volume

+ = less than 1%

stockpiling and processing goosefoot seeds, and possibly for storage in the central, bell-shaped pit. Some plant processing also may have taken place around the exterior features, but with different plants and with much less intensity. However, it is also possible that the types and minor amounts of seeds from the exterior features may be representative of prehistoric, natural seed rain rather than processing activities.

Plant Microfossils

In order to derive evidence of subsistence (Table 9), a total of 19 pollen samples from within and around 8 cultural features in Component 2 was analyzed. Five types of pollen were found in significantly higher frequencies than were observed in the control samples considered to represent background pollen rain. These five types represent plants that are known to have been exploited by native populations in the area during historic times (Yanovsky 1936). Although this evidence in the pollen results may not by itself be considered as inherently indicative of prehistoric exploitation of these plants, it serves as a contributing line of evidence to be considered.

The five pollen types are Cheno-am (Chenopodiaceae and Amaranthaceae families), sagebrush (*Artemisia* sp.), grass (Gramineae family), nightshade (Solanaceae family), and buckwheat (*Eriogonum* sp.). Cheno-am was found to be the common denominator in the samples from features as well as in the controlled column samples and modern surface samples. The common presence of Cheno-am aggregates in the feature samples suggests the direct introduction of plant parts or at least that these plants were growing on the site. The two pit structures were sampled for pollen by taking columns through the centers of their fill to observe the sequence of plant succession following their abandonment and natural refilling. Generally, both structures show similar sequences. Cheno-am pollen (representing pioneer weeds) was in the highest frequencies toward the bottoms of their fills, toward the middle were increasing frequencies of High-spine Compositae (such as rabbit-brush and snakeweed), toward the middle, and the highest frequencies of sagebrush were in the upper portions, indicating that sagebrush eventually took over as the depressions were filled. In both structures, the frequencies of Cheno-am aggregates from the lowest, floor samples suggest that this plant was processed in the structures. Higher frequencies of sagebrush may reflect the material from which the superstructures were made. A pollen wash taken from a fragment of groundstone from the floor of one pit structure (Feature 16) produced results similar to those from the structure floor as well as a large value of grass pollen. This suggests the groundstone was used to grind grass seeds. Samples taken from directly outside each pit structure (in Feature 7 and in and northeast of Feature 15) showed pollen records similar to those from the structure floors with Cheno-am and aggregates dominating. In the midden concentration (Feature 15) adjacent to one pit structure, high frequencies of sagebrush were observed. This suggests the use of sagebrush as fuel in pits from which fill was removed and deposited there, or perhaps it reflects the construction material of the adjacent structure.

Features from activity areas exterior to the pit structures were also sampled for pollen. In the group of four features to the south of the pit structure in Activity Area A, two pits (Features 36 and 37) produced similar results: high frequencies of Cheno-am and aggregates

Table 9. Summary of the results of pollen analysis from Component 2 at the Buffalo Hump site.

Sample Number	Source	Pollen types recovered in significantly high frequencies
132	Feature 7 interior	Cheno-am
207	Feature 15 interior	Cheno-am aggregates, sagebrush
218	Feature 15 exterior	Cheno-am and aggregates
291	Feature 26 interior	Insufficient
300 - 306	Feature 27 interior column	Cheno-am and aggregates (floor)
314 A - D	Feature 16 interior column	Cheno-am and aggregates (floor)
647	Feature 34 interior	Cheno-am and aggregates, nightshade, grass
697	Feature 36 interior	Cheno-am and aggregates, grass
813	Feature 37 interior	Cheno-am and aggregates, grass and aggregates, and buckwheat
885	Groundstone in Feature 16	Cheno-am and aggregates, grass

and grass pollen as well as buckwheat from one. In Activity Area C, the one basin feature also showed high frequencies of Cheno-am and aggregates and grass and the only occurrence of nightshade pollen at the site.

The evidence in the pollen analysis suggests that goosefoot may have been the most commonly utilized plant in all three activity areas, or at least that it was the most common weed growing on the site at this time. Sagebrush appears to have been used as fuel and possibly for construction material of one structure. Grass seeds may have been exploited and ground on sandstone slabs, and buckwheat and nightshade may have supplemented the floral subsistence base.

Summary

The occupation represented by Component 2 took place about 1400 years ago and produced a patterned distribution of cultural remains into three discrete areas. Two of the areas were centered around pit structures, with evidence of activity both within and around the structures. The third area was apparently exterior to the pit structures, although a surface structure may have been present in a pattern similar to the others. The basis of subsistence appears to have been diverse, with a strong emphasis on wild plant foods of local origin, supplemented by animal food resources. Bison and pronghorn were exploited primarily for complete recovery of the nutritional value present in their limbs, and smaller animals, such as jackrabbits, were procured as whole carcasses for consumption. Carnivores were also hunted for their furs or as fortuitous encounters during the course of other subsistence activities. The bones from the animals acquired for food were also used to manufacture tools and ornamental objects, the latter of which seems to have been an important part of the material culture as evidenced by the abundance of beads made from bone as well as juniper seed. Other tools made from flaked stone from raw materials available in the immediate vicinity appear to have been manufactured to a limited extent on the site. The projectile points are representative

of the Rose Spring type, or side-notched varieties of similar size, which is consistent with the radiocarbon age of this component.

Component 3

The Component 3 occupation took place around 1200 years ago, about 200 years after Component 2, but still in the early part of the Late Prehistoric period. The cultural remains were distributed across the entire northern one-half of the excavation block, roughly describing three concentrations. Another area was encountered 15 m west of the block in the pipeline trench and nearby excavations. Much of the evidence in this component is very similar to that from Component 2. Like Component 2, this occupation appears to represent a habitation camp that was used for some time in the late summer or fall by a small group composed of one or two nuclear families.

Features

Within the excavation block, a total of 14 features, representing four types, was found to be associated with Component 3 (Figure 27). As in Component 2, three activity areas are defined by groups of features and their associated cultural debris. A fourth area became apparent when a pit structure was encountered in the pipeline trench about 15 m west of the block. These concentrations of cultural remains were designated Activity Areas A, B, and C within the excavation block and Activity Area D to the west. In the following discussion, the first three activity areas are described by reference to the remains found within them. As can be seen in Figure 27, the distinction between the three activity areas is not defined by wide gaps in the cultural debris, as in Component 2; so the inclusion of some remains into one or another activity area was somewhat arbitrary and based primarily on proximity to central features. In Chapter 5 more detailed analysis of spatial distribution within the activity areas is presented. Because of its different context, Activity Area D may be described only in general terms and with less detailed attention to the features and cultural remains. Activity Areas A and D were composed of pit structures and their interior and exterior associations. Activity Areas B and C were exterior loci not directly associated with pit structures.

Activity Area A was situated to the east of the others and was composed of a pit structure, its four interior features, and two exterior features to the east and southeast (Figure 27). The pit structure, Feature 8 (Figures 28 and 29), was disturbed by the Frontier pipeline trench, which removed its northern margin. At the time of the archaeological monitor of the Frontier pipeline (Brechtel et al. 1984), the pit structure was not recognized as such, probably because of the small size of the exposed portion. At that time, a 1 x 1 m unit, Excavation Unit 5 (Brechtel et al. 1984:144), was excavated through the center of the stain that represents Feature 8 (Figures 28 and 29). Five small, shallow, basin-shaped pits were documented in that test unit, three of which appear to be parts of Features 17, 18, and 20 (McKern 1986; Schoen 1986) documented fully during the AS-WWC 1985 excavations. The two others may have been small pits similar to Feature 20, or they may have been depressions in the structure floor. Apparently they were located in the center of the 1 x 1 m unit. After complete excavation, the pit structure was defined as being similar in shape and dimension to

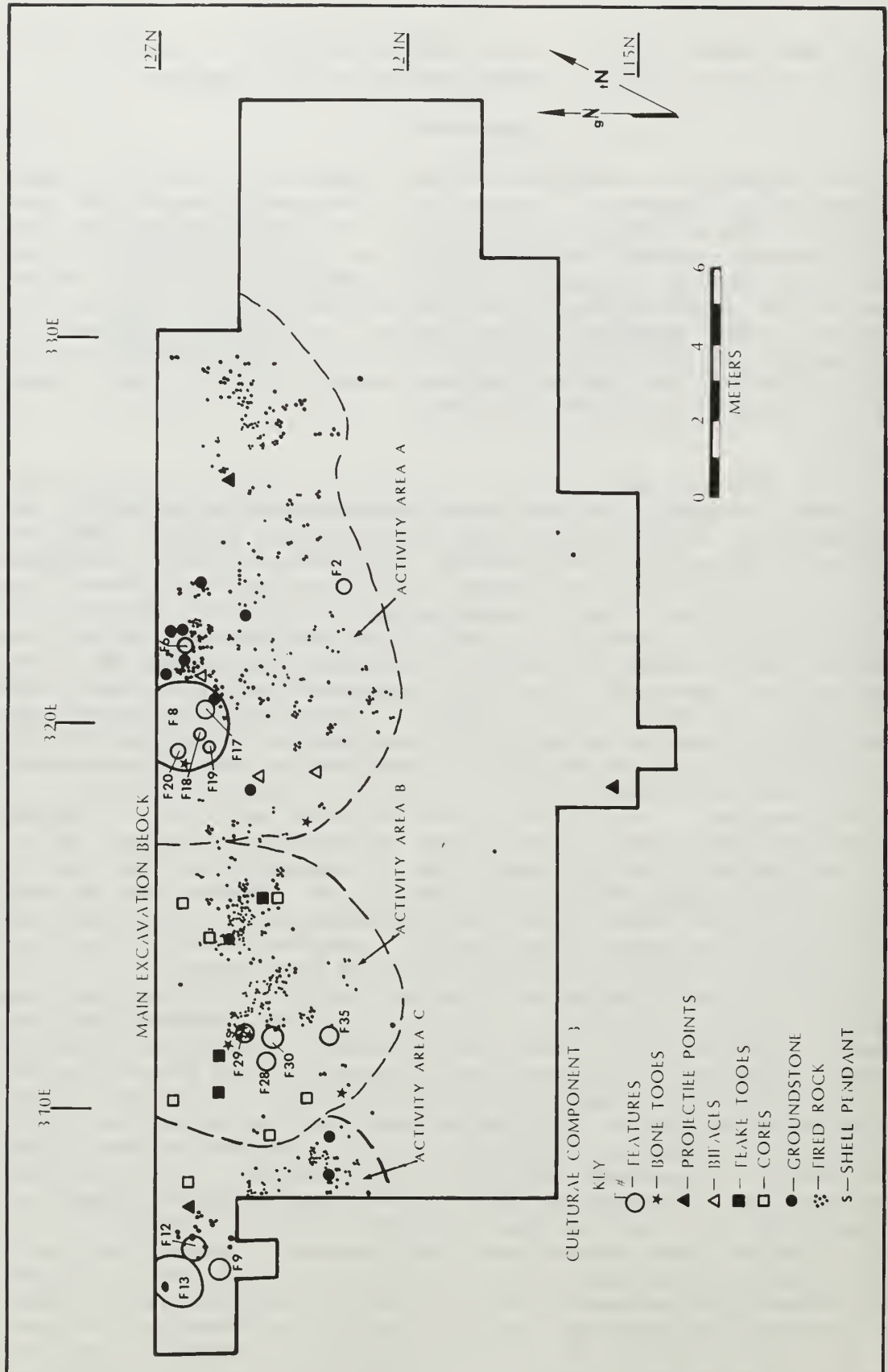
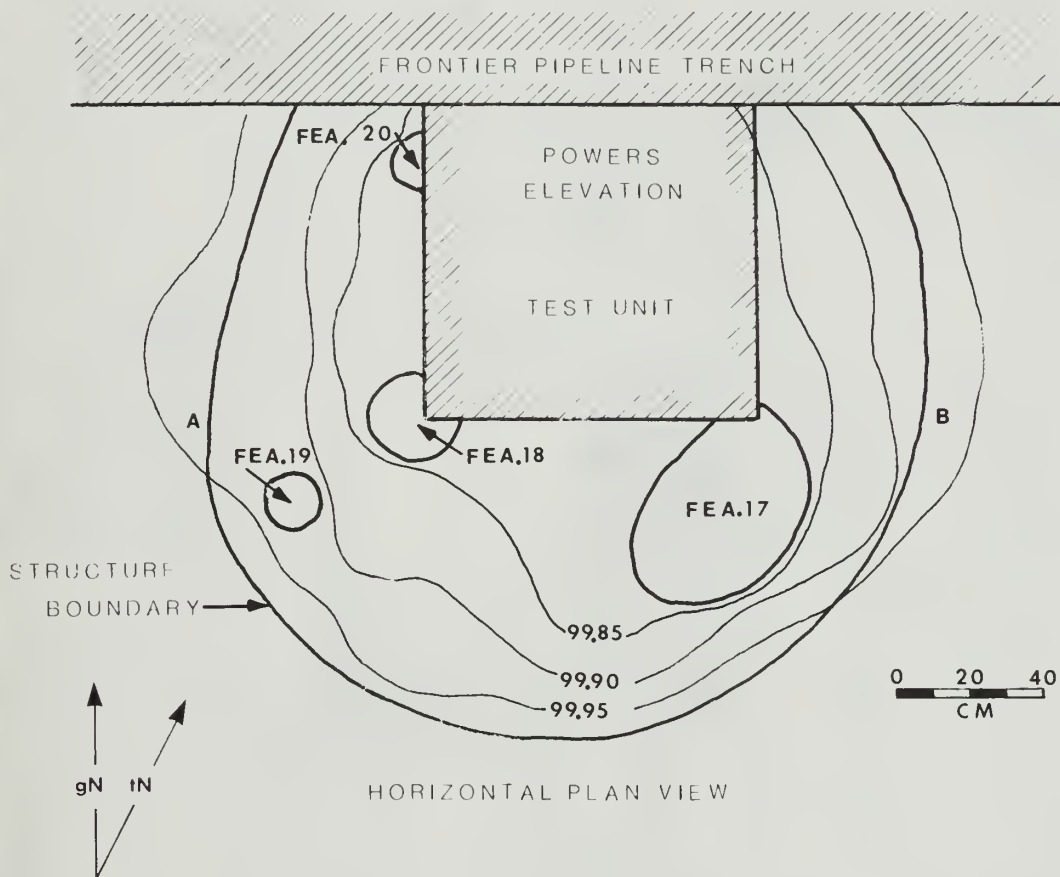


Figure 27. Plan map of the main excavation block showing the three activity areas and the locations and types of cultural remains recovered from Component 3 at the Buffalo Hump site. (This illustrates all artifacts and fired rock from in situ contexts with artifacts from screened 1 x 1 m lots plotted in the center of the unit from which they were recovered.)

PIT STRUCTURE

FEATURE 8



HORIZONTAL PLAN VIEW

Elev.
100,10M

CROSS SECTION

100,10M

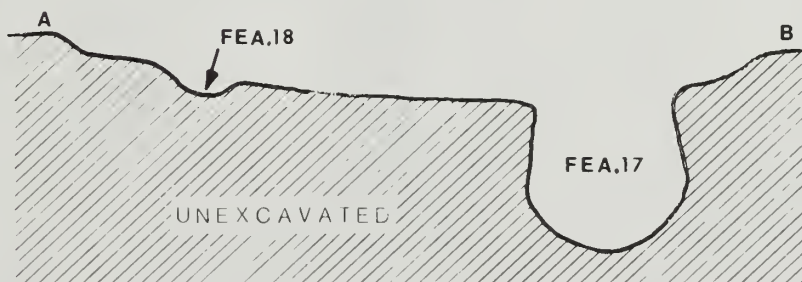


Figure 28. Graphic illustration of plan view and cross section of a pit structure (Feature 8) from Activity Area A in Component 3 at the Buffalo Hump site.



Figure 29. Post-excavation photograph of a pit structure (Feature 8) from Activity Area A in Component 3 at the Buffalo Hump site. (The arrow points grid north; photo board and arrow placed in PEC Test Unit.)

Feature 16 from Component 2, but with a different configuration of interior features. A large, oxidized, bell-shaped pit, Feature 17 (Figures 30 and 31), was documented from the center of the southeast quadrant of the structure's floor. In the western one-half of the floor, three other smaller features were recorded: a small, unoxidized, basin-shaped pit (Feature 20) and two irregular, shallow basins (Features 18 and 19). Feature 18 may have been a medium-sized, basin-shaped pit that was well defined in the PEC unit (McKern 1986; Schoen 1986) and a poorly defined remnant in the AS-WWC excavations.

Outside the pit structure within Activity Area A, two small, unoxidized, basin-shaped pits were documented in the excavation block. One of these (Feature 6) was situated 1 m to the east of the pit structure, and the other (Feature 2) was located 4 m southeast of the pit structure in a context nearly isolated from other features and cultural remains. The cultural debris associated with this activity area was scattered to the south and east of the pit structure as far as 10 m away. More associated cultural remains may still be present north of the Frontier pipeline trench. Two other features were recorded by PEC (Brechtel et al. 1984:144-147) 1 m to the northeast of the pit structure in their Excavation Unit 6. One (Feature 6A) was a large, oxidized, bell-shaped pit (see Figure 3 in Appendix A) that contained four intact, charred logs of sagebrush or rabbitbrush in the bottom of the pit. The other (Feature 6B) appeared to be a small, oxidized, bell-shaped pit located 23 cm northwest of the large pit (McKern 1986).

Activity Area B (see Figure 27) was situated to the west of Activity Area A and was composed of three adjacent pit features (Figure 32) with a fourth feature located 1 m south. The three adjacent features (Features 28, 29, and 30) were originally described as a "tri-hearth complex" (Newberry et al. 1986:40). This term is misleading because clusters of features, although common, do not always occur in groups of three. This turned out to be the case here after a fourth feature (Feature 35) was documented later. This group of features was composed of a medium-sized, oxidized, bell-shaped pit (Feature 30), a medium-sized, oxidized, basin-shaped pit (Feature 29), and a medium-sized, unoxidized, basin-shaped pit (Feature 28) in close association with another medium-sized, unoxidized, basin-shaped pit (Feature 35) located 1 m south of the others. The associated cultural debris was found scattered primarily to the east of the features, between them and the pit structure in Activity Area A.

Activity Area C (see Figure 27) was similar to Activity Area B in its pattern of features and their types. In Activity Area C, three adjacent features (Figure 33), including an oxidized, bell-shaped pit (Feature 12) and an oxidized, basin-shaped pit (Feature 9), were documented in a tight cluster. A fourth feature (Feature 40) was encountered 1.5 m south of the cluster during the monitor of blading for Exxon pipeline construction. This fourth feature may have been a small, basin-shaped pit, although evidence of its shape in profile was not acquired. In the cluster of three features, the large, oxidized, bell-shaped pit (Feature 12) was originally encountered during investigations of the Frontier pipeline trench (Brechtel et al. 1984:138). At that time, PEC Excavation Unit 3 exposed part of Feature 12, which they designated as Feature 3B, and excavated the northern one-third of the feature that was within the unit. Also located in this unit were two, poorly defined, shallow stains which might have been disturbed remnants



Figure 30. Post-excavation photograph of a large, oxidized, bell-shaped pit (Feature 17) located in a pit structure (Feature 8) from Activity Area A in Component 3 at the Buffalo Hump site (arrow points grid north).

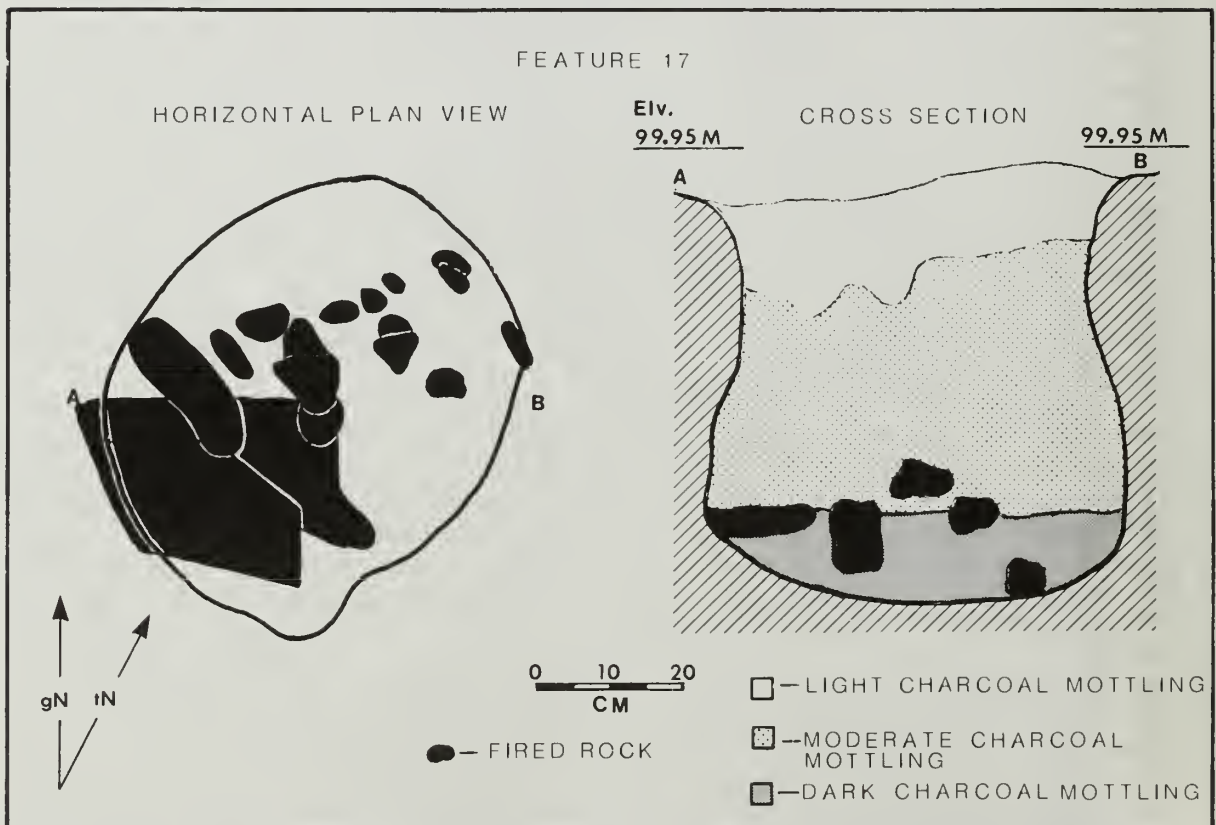


Figure 31. Graphic illustration of the plan view and cross section of Feature 17 from Activity Area A in Component 3 at the Buffalo Hump site.



Figure 32. Post-excavation photograph of three adjacent features (Features 28, 29, and 30) from Activity Area B in Component 3 at the Buffalo Hump site (arrow points grid north).

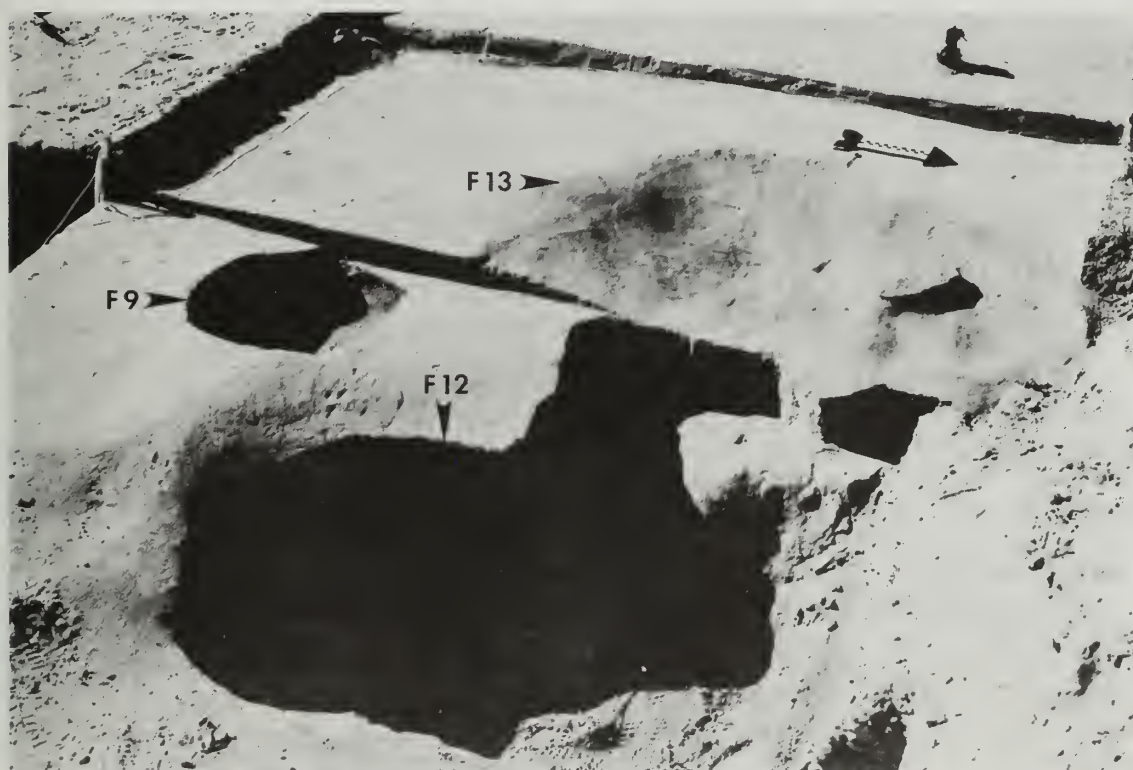


Figure 33. Post-excavation photograph of three adjacent features (Features 9, 12, and 13) from Activity Area C in Component 3 at the Buffalo Hump site (arrow points grid north).

of basins or, more likely, the remains of ashes and coals removed from the bell-shaped pit. The remainder of this pit (Feature 12) was excavated by AS-WWC, at which time the two adjacent features were documented. A medium-sized, oxidized, basin-shaped pit (Feature 9) was located to the south of the bell-shaped pit and a large, irregular, shallow basin (Feature 13) was situated to the east. Associated cultural debris was scattered to the southeast of these features up to 5 m away.

Activity Area D was located between 9 and 18 m west of the main excavation block and was represented by a pit structure, Feature 48 (Figure 34), documented in profile from the Exxon pipeline trench, and cultural material recovered from a small (18 m²) excavation block (Block C) to the east of the pit structure (see Figure 3 in Appendix A). Originally, Block C was excavated to expose more of a cultural lens encountered in a test unit. Because no features were discovered, minor amounts of cultural material were recovered, and bedrock was found to be buried by no more than 30 cm of eolian deposits, excavation in this block was terminated. Later the pit structure was exposed just 3 m east of Block C. In profile, this pit structure appeared to have dimensions and a shape very similar to the others recorded in the main block, and the typical bell-shaped pit (Feature 49) was exposed on its eastern edge. Because similar cultural manifestations were documented during mitigation, no work was conducted on this pit structure other than documenting the portions exposed by the trench and obtaining a radio-carbon age, which is the basis for its association with Component 3. The cultural remains from the adjacent excavations include a few pieces of fired sandstone, 14 fragments of bone from a large mammal, a core, a tested cobble, and 20 pieces of lithic debitage of the same materials as the core and cobble. No other data are available from Activity Area D.

Material Culture

The artifacts recovered from Component 3 consist of a small sample of flaked lithic tools and debitage, groundstone, and modified bone and shell. Artifacts were recovered from each of the activity areas.

Flaked Lithic Artifacts

Flaked lithic artifacts are represented by 4 projectile points, 3 hafted bifaces, 1 retouched flake, 2 utilized flakes, 8 cores (Table 10), and 359 pieces of debitage. A detailed analysis of these artifacts is presented in Appendix B.

The very small sample of tools is represented by seven formal and three expedient tools. The most common raw material type is biogenic chert. Algalitic chert is represented in the formal tools, and the expedient tools are made of chert from pelagic origin. The other materials are authigenic and oolitic chert, chalcedony, and ortho-quartzite. Most (70%) of these tools were recovered as complete, or nearly complete, specimens.

The projectile points are represented by three defined types (Figure 35). One specimen of Type I (Figure 35a) was recovered from Activity Area C. This type resembles the Ruby Corner-notched points defined in components of similar age from the Plains to the east (Irwin and Irwin 1959; Irwin-Williams and Irwin 1966). Two specimens are identified as Type II (Figure 35b, c), which is equivalent to the Rose Spring type from the early part of the Late Prehistoric period in the

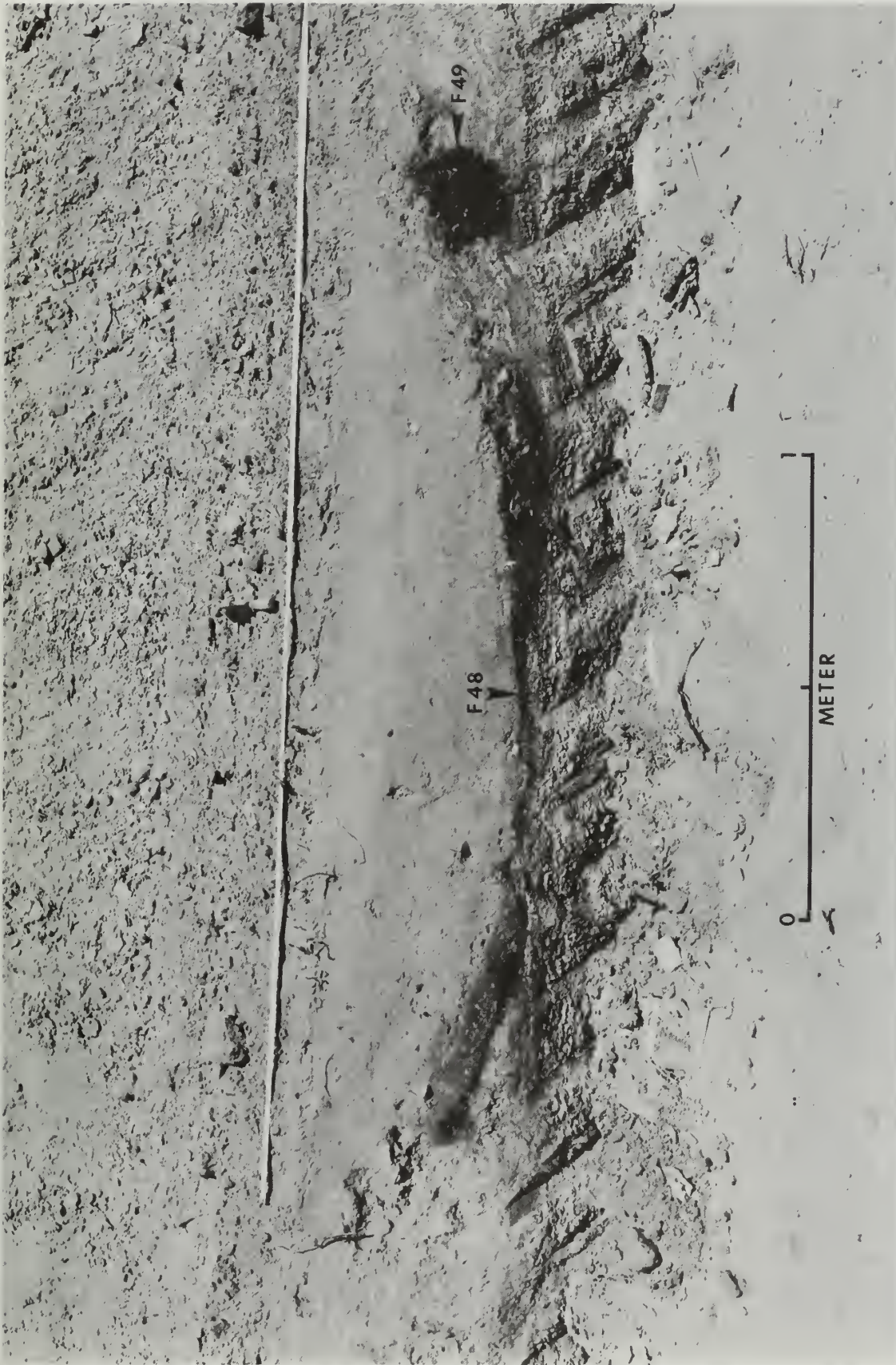


Figure 34. Photograph of the profile of the pit structure (Feature 48) and the bell-shaped pit (Feature 49, on the right) as they appeared in the north wall of the pipeline trench, representing Activity Area D from Component 3 at the Buffalo Hump site (view looking grid north).

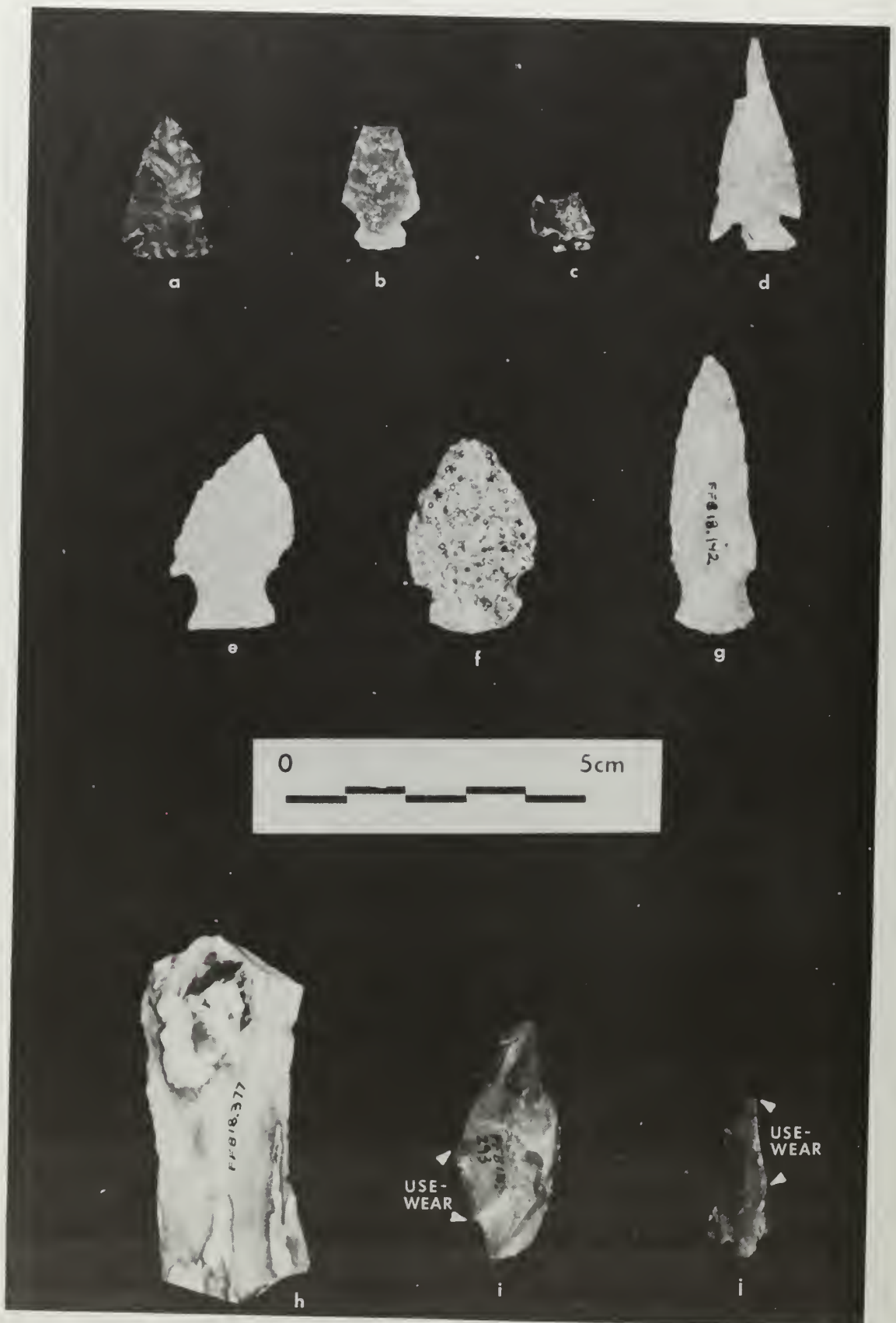


Figure 35. All flaked lithic tools recovered from Component 3 at the Buffalo Hump site: Type I (Ruby Corner-notched) projectile point (a); Type II (Rose Spring) projectile points (b, c); Type III (Indeterminate corner-notched) projectile point (d); hafted bifaces (e-g); retouched flake (h); and utilized flakes (i, j).

Table 10. Summary of flaked lithic tools from Component 3 at the Buffalo Hump site.

Tool Class/Type	Raw Material					Total
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Chalcedony	Ortho-quartzite	
Projectile point						
Type I	1	-	-	-	-	1
Type II	-	2	-	-	-	2
Type III	-	-	-	1	-	1
Hafted biface	-	1	1	-	1	3
Retouched flake	1	-	-	-	-	1
Utilized flake	-	2	-	-	-	2
Core						
Discoidal	-	2	1	-	-	3
Bidirectional	-	1	-	-	-	1
Multidirectional	-	1	-	-	-	1
Tabular	-	3	-	-	-	3
Total	2	12	2	1	1	18

Great Basin (Holmer 1986) and portions of Wyoming (Smith 1987c). The fourth specimen represents Type III (Figure 35d), which also resembles the Rose Spring type but was not identified as such because of the longer blade and greater width of the corner notches. This last specimen was recovered from near the southern edge of the excavation block, outside the area defined for Component 3, but from clear stratigraphic association. One of the Type II points was found on the surface from just outside the northeast corner of the excavation block, and the other Type II base fragment was recovered from Activity Area A.

The hafted bifaces (Figure 35e-g) resemble projectile points in their shape but are classified differently because of the traces of use-wear on their blade edges. All three specimens are from Activity Area A and are complete tools with expanding stems as haft elements.

The expedient tools are represented by a retouched flake (Figure 35h) and two utilized flakes (Figure 35i, j). All three were recovered from Activity Area B as complete specimens. The retouched flake is unifacially modified on one edge and has traces of wear in the form of step fractures, reflecting use as a scraping implement. The utilized flakes also appear to have been used for scraping, which produced submicroflake scars on one side of their edges.

The eight cores (Figure 36) from this component represent four different types and two kinds of raw material. Most (88%) are biogenic cherts (stromatolitic and algalitic), but oolitic chert is represented by one specimen. Discoidal and tabular cores are the most common types, and bidirectional and multidirectional cores are represented by one specimen each. Most (75%) of the cores came from Activity Area B, the others from Activity Areas C and D.

The debitage from Component 3 is composed of 359 flakes from all stages of the reduction sequence (Table 11). Biogenic cherts are the



Figure 36. All cores recovered from Component 3 at the Buffalo Hump site: discoidal cores (a-c); tabular cores (d-f); bidirectional core (g); and multidirectional core (h).

Table 11. Summary of lithic debitage from Component 3 at the Buffalo Hump site.

Reduction Stage	Raw Material					Total	Percent of Total	Percent of Total by technological type
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Dendritic Opal	Meta-quartzite			
Primary flake	10	12	3	-	2	27	8%	
Primary microflake	4	4	4	-	-	12	3%	12%
Primary flake fragment	2	1	-	-	-	3	1%	
Secondary flake	20	32	11	-	-	63	18%	
Secondary microflake	16	14	2	2	-	34	9%	31%
Secondary flake fragment	4	6	2	-	1	13	3%	
Tertiary flake	20	30	12	-	1	63	18%	
Tertiary microflake	36	35	5	3	2	81	23%	
Tertiary submicroflake	1	2	-	-	-	3	1%	50%
Tertiary flake fragment	11	14	7	1	1	34	9%	
Biface Thinning flake	3	3	2	1	-	9	3%	3%
Shatter/Chunk	5	7	1	-	-	13	4%	4%
Tested material	1	2	-	-	1	4	1%	
Total	133	162	49	7	8	359	100%	
Percent of Total	37%	45%	14%	2%	2%	100%		

most common material type. Authigenic and oolitic chert, dendritic opal, and metaquartzite are represented. All of these raw materials can be found in the immediate vicinity of the site as relatively small (fist-sized) cobbles.

The technological stages represent the full range of the reduction sequence in a pattern similar to that of Component 2. All primary flakes make up 12% of the total, secondary flakes represent 31%, and tertiary flakes comprise 51%. Only 3% biface thinning flakes, and 4% are other types. Microflakes are well represented in the total debitage sample (35%) and in each of the three major technological types: 29% of the primary flakes, 31% of the secondary flakes, and 45% of the tertiary flakes. As in Component 2, these proportions of microflakes may be a

reflection of the relatively small sizes of the raw material. The minor amounts of biface thinning flakes and submicroflakes may be indicative of less emphasis on final stages of tool production or may be a product of the sampling technique. Generally, the proportions of the technological types of flakes indicate that tools were being manufactured on the site from raw materials obtained in the immediate area. The presence of cores supports this interpretation, although specimens from intermediate stages of tool production are markedly absent in this component. Overall, the small amounts of flaked lithic artifacts and debitage suggest that manipulation and use of flaked stone was practiced, though not as a primary emphasis during this occupation of the site.

As will be discussed in detail in Chapter 5, the spatial distribution of the debitage was fairly even in minor amounts across the northern portion of the excavation block. There were two concentrations apparent in Activity Areas A and B. In Activity Area A, the concentration of debitage occurred directly to the east of the pit structure. In Activity Area B, which contained most of the cores, the concentration was located directly to the east of the cluster of three adjacent features.

Groundstone

A total of 11 specimens of groundstone was recovered from Component 3. These are represented by fragments of sandstone slabs, one shaped mano, and one indeterminate object. The mano fragment (Figure 37) is composed of three specimens that fit together to form the larger fragment, the pieces of which were recovered from within 6 m of each other within Activity Area A outside the pit structure. None of the slab fragments are complete enough to determine the original shape(s) of the artifact(s). Six of the seven slab fragments are burned, and all appear to have been acquired from outcrops that occur on and around the site.

The indeterminate object (see Figure 3 in Appendix B) is a small, thin piece of tabular sandstone which has been ground smooth on all edges to form a rectangular shape with a concavo-convex cross section. This artifact may represent some type of nonutilitarian item, such as a gaming piece, or the preliminary stages of manufacture of an ornament.

With the exception of Activity Area D, groundstone artifacts were recovered from all activity areas. The majority (73%) came from Activity Area A: the three mano fragments, three slab fragments, and the indeterminate object from around the pit structure and one slab fragment from within the structure. In Activity Area B, a burned slab fragment was recovered from a concentration of fired rock located to the east of the feature cluster and two slab fragments were found in a similar context in Activity Area C. Most of these groundstone artifacts are evidence of plant processing that must have been a primary emphasis during this occupation in three of the activity areas. Further evidence of plant processing can be found in the remains of plant macrofossils and microfossils, described below.

Modified Bone

Seven specimens of modified bone (Table 12) were recovered from Component 3, representing two defined types and miscellaneous objects of unknown function. The defined types are composed of an awl and four



Figure 37. Illustration of shaped mano fragment recovered in three pieces from Activity Area A in Component 3 at the Buffalo Hump site.

Table 12. Summary of types of modified bone from Component 3 at the Buffalo Hump site.

Animal Element Portion	Type			Figure	Total
	Awl	Tube	Miscellaneous		
Pronghorn Metatarsal Middle, anterior shaft	1	-	-	38a	1
Large mammal Flat bone Body	-	-	1	38f	1
Medium to large mammal Rib Body	-	-	1	38g	1
Jackrabbit Humerus Distal shaft	-	1	-	38b	1
Tibia Distal shaft	-	1	-	38c	1
Metatarsal Middle shaft	-	1	-	38e	1
Small mammal Long bone Middle shaft	-	1	-	38d	1
Total	1	4	2		7

tubes, or beads. The tubes are all made from the bones of jackrabbit and small mammal, and the awl is made from a pronghorn metatarsal. The awl, one tube, and one miscellaneous object were recovered as complete specimens, and the remainder of bone artifacts are fragments. Three of the fragmentary tubes and the miscellaneous fragment are burned.

The awl (Figure 38a) represents an expedient tool made from a spirally fractured fragment of metatarsal from a pronghorn. One end of the shaft fragment was shaped to form an acute point, and subsequent use produced a high sheen on the pointed end. This tool was found 20 cm north of the oxidized, basin-shaped pit (Feature 29) in the feature cluster within Activity Area B.

All four of the bone tubes (Figure 38b-e) were found in Activity Area B. The three burned fragments came from within Feature 29, and the complete specimen was recovered from 1 m west of Feature 35 and 2 m southwest of the group of three features. Unlike Component 2, no tube discards were found, although these finished tubes appear to have been made from jackrabbit bones in a manner similar to the specimens from the earlier occupation.

Both miscellaneous objects were found in Activity Area A. The complete specimen (Figure 38f) was recovered from the floor of the pit structure. It is a tiny piece of bone wall that was modified to form an ovoid outline and a flat cross section. Numerous striations are present on one of the flat surfaces. Its size, shape, and characteristics are unlike any other artifact from the archaeological literature, which

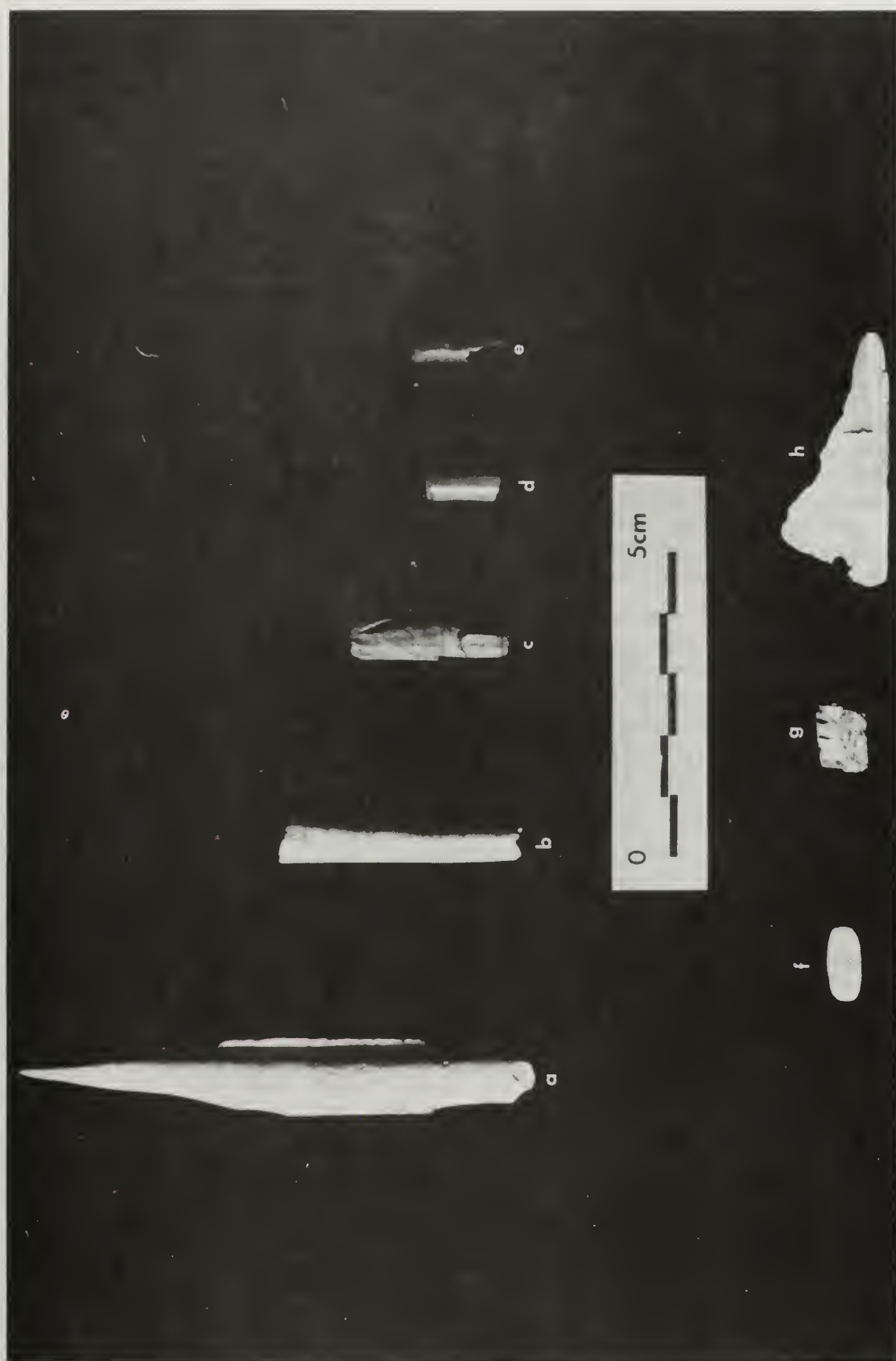


Figure 38. All modified bone and shell artifacts recovered from Component 3 at the Buffalo Hump site: bone awl (a); bone tubes (b-e); miscellaneous bone objects (f, g); and perforated mussel shell fragment (h).

makes determination of function difficult. It may be a small gaming piece or counter, an unfinished ornament, or a part of some larger object. The other miscellaneous specimen (Figure 38g) is also difficult to relate to a function. This small rib fragment has two deep incisions and a shallow one on one side, all evenly spaced and of similar dimensions; one of the broken ends has the remnants of a fourth incision. The uniform characteristics of the incisions are not like marks resulting from butchering, but appear to have been fashioned intentionally. This specimen may represent a discard from early stages of tool or ornament manufacture, or it may be a fragment of a finished object. It was recovered from 3 m southwest of the pit structure in Activity Area A.

Modified Shell

A modified fragment of a freshwater mussel shell (Figure 38h) was recovered from the northeast edge of Feature 29 in Activity Area B. One of the broken edges has the remains of a bifacially drilled hole, suggesting that this specimen may have been an ornament such as a pendant. The shell could have broken when the hole was drilled, because only one-half of the hole remains. However, the hole appears to have been completed and its margins smoothed, suggesting that the object was broken after completion and use.

Faunal Remains

A total of 517 faunal specimens weighing 305.9 g was recovered from Component 3 (Table 13). The small size of this sample of faunal remains limits its interpretive value although it reflects some aspects of the subsistence base during this occupation.

Four taxa are identified: bison, coyote/dog, jackrabbit, and rodent. A fifth taxon is also represented in the bone awl made from a pronghorn metatarsal, although the modified bone is not included in these faunal remains and the awl may not be representative of refuse from subsistence activities. Other general taxa probably represent the four specific taxa: large, medium to large, medium, and small to medium mammals. Because the specific taxa are represented by less than 10% of the total, consideration of the equivalent sizes of nonspecific taxa increases the interpretive potential. Generally, bison and large mammals are equivalent, coyote/dog is analogous to medium mammals, and jackrabbit and rodent correspond with small to medium mammals. The medium to large mammal category is generally applicable to bison and coyote/dog, although for the purpose of making comparisons, it is considered as representative of the larger end of the scale, encompassing bison. The combined numbers and weights of the large animals represent the largest proportion of the sample (76% by number and 95% by weight). The small animals make up 21% by number and 4% by weight, with coyote/dog and medium mammals represented by the smallest proportions (4% by number and 1% by weight). As was the case with Component 2, the subsistence base during this later occupation was similar in its emphasis on large game with small animals and a carnivore acquired to supplement that diet or for other reasons, such as provision of furs and/or bones from which to manufacture ornaments.

Most (99%) of the faunal remains are fragments of bone elements, and the majority (75%) of the fragments are less than 2 cm in maximum dimensions. The only complete bones are the small, dense, compact

Table 13. Summary of faunal remains recovered from Component 3 at the Buffalo Hump site.

Taxon	Number of Specimens	Total Weight	MNI
Bison	3	89.4	1
Coyote/dog	4	1.3	1
Jackrabbit	17	9.4	2
Rodent	16	0.3	1
Large mammal	138	151.0	-
Medium to large mammal	250	49.8	-
Medium mammal	16	2.2	-
Small to medium mammal	73	2.5	-
Total	517	305.9	5

elements of the distal extremities of coyote/dog and jackrabbit: five podials and a phalange. The high degree of fragmentation partially accounts for the small proportion of identified elements and taxa. In the entire sample, most (85%) of the identified elements are nonspecific long bone shaft fragments, and 80% of these are classified as large and medium to large mammals. This evidence suggests an emphasis on extraction of complete nutritional value from the animal resources in which long bones were fractured for removal of marrow and then fragmented further to extract bone juice or grease. Of the identified elements of the large animals, bones of the limbs and their distal extremities are dominant. There are minor proportions of trunk elements and no crania represented. In contrast, the medium and smaller animals are represented by more even proportions of elements of the entire body. This suggests that the smaller animals were probably brought to the site as whole carcasses whereas the large game animals seem to have been killed off the site and their limbs primarily selected for transport to the site in order to extract optimal amounts of the nutrients concentrated in these elements.

Plant Macrofossils

A total of 1478 charred seeds was recovered from 12 of the 14 sampled features in Component 3 (Table 14). The majority (84%) of seeds are from goosefoot plants, but povertyweed, mustard family, sedge, sagebrush, Indian ricegrass, grass family, beeweed, phacelia, sunflower, Utah juniper (*Juniperus osteosperma*), and unknown taxa are represented. Almost all (96%) of the charred seeds were recovered from the pit structure and its associated features. Most (84%) of these are goosefoot seeds, which represent 96% of the total goosefoot seeds from all features in this component. Two-thirds of all seeds from all features came from the large, bell-shaped pit (Feature 17) in the pit structure. The features external to the pit structure not only produced

Table 14. Summary of plant macrofossils recovered from Component 3 at the Buffalo Hump site.

Feature Number	Volume of Sample	Number of Charred Seeds	Plant Taxa (in order of greatest frequencies)
6	5.0 liter (100%*)	41	Goosefoot, povertyweed
8	15.0 liter (2%)	342	Goosefoot, povertyweed, unknown, sedge, Indian ricegrass, mustard, sagebrush, sunflower, Utah juniper
9	15.0 liter (100%)	1	Beeweed
12	12.5 liter (18%)	4	Goosefoot, beeweed, Indian ricegrass
13	15.0 liter (49%)	2	Goosefoot, unknown
17	10.0 liter (12%)	986	Goosefoot, povertyweed, mustard, sedge, sagebrush, grass
18	5.0 liter (62%)	39	Goosefoot, mustard, grass
19	5.0 liter (100%)	22	Goosefoot, povertyweed, mustard
20	2.0 liter (100%)	34	Goosefoot, povertyweed, unknown
29	12.5 liter (83%)	3	Unknown
30	12.5 liter (51%)	3	Goosefoot
35	5.0 liter (36%)	1	Phacelia
Total seeds		1478	

*percent of total feature volume

much fewer seeds, but yielded more seeds from plants other than goosefoot, such as Indian ricegrass, beeweed, and phacelia. The exception is Feature 6, located 1 m east of the pit structure, from which a significant amount of goosefoot seeds was recovered.

The evidence in the plant macrofossils indicates that the pit structure may have been a shelter which served a specialized function for stockpiling and processing goosefoot seeds, and possibly for long term storage in the bell-shaped pit. Outdoor processing of goosefoot seeds also may have occurred on the leeward side of the shelter in Feature 6. Other exterior activity areas probably were not used for seed processing to such an extent, and the few macrofossils from these features may have been deposited primarily as a result of prehistoric, natural seed rain.

Plant Microfossils

A total of 11 pollen samples was analyzed from within and around eight cultural features in Component 3 for the purpose of interpreting evidence of subsistence (Table 15). Four types of pollen were identified in significantly high frequencies: Cheno-am (Chenopodiaceae and Amaranthaceae families), sagebrush (Artemisia sp.), grass (Gramineae family), and High-spine Compositae (such as rabbitbrush). A fifth type, sawatch knotweed (Polygonum sawatchense), is represented by a single grain. As in Component 2, Cheno-am pollen is the most common type identified from the features and the control column. The occurrence of aggregates of Cheno-am pollen in several of the samples indicates that the plants were growing nearby or that parts of these plants were introduced directly into the areas from which the samples were taken.

The samples from the pit structure in Activity Area A showed high frequencies of Cheno-am and aggregates, suggesting that these plants may have been processed in the structure. Some type of High-spine Compositae also may have been processed in the northwest portion of the structure, and grasses may have been introduced into the northeast portion of the floor. The bell-shaped pit (Feature 17) in the southeast part of the structure floor may have been used to store or roast parts of some plant in the Chenopodiaceae family, as reflected in the high frequencies of Cheno-am aggregates. The exterior sample taken to the south of the pit structure exhibited a smaller quantity of Cheno-am than the interior samples but a higher frequency of sagebrush. This reflects a pattern similar to one of the pit structures (Feature 16) in Component 2 where samples from the leeward side of the pit structure exhibit sagebrush pollen. This possibly reflects pollen rain from a superstructure constructed of sagebrush, a dump area with charcoal and ashes from hearths that burned sagebrush, or simply the natural background pollen rain.

In Activity Area B, samples from the cluster of three features did not produce pollen in sufficient frequencies to indicate economic use of plants. In Activity Area C, the amounts of Cheno-am aggregates from two of the three features may be suggestive of processing some plant in the Chenopodiaceae family in this area. The single grain of sawatch knotweed is not conclusive evidence of its economic use.

The evidence in the pollen record from the cultural features in Component 3 suggests that goosefoot may have been the dominant plant that was utilized at this time, or at least that it was the most common pioneer weed growing on the site during this occupation. Given only the

Table 15. Summary of the results of pollen analysis from Component 3 at the Buffalo Hump site.

Sample Number	Source	Pollen types recovered in significantly high frequencies
152	Feature 9 exterior	Cheno-am and aggregates, sawatch knotweed
173	Feature 12 interior	Insufficient
186	Feature 13 interior	Cheno-am and aggregates
195	Feature 8 interior floor (S½)	Cheno-am
196	Feature 8 interior floor (NW¼)	Cheno-am and aggregates, High-spine Compositae
197	Feature 8 interior floor (NE¼)	Cheno-am, grass
232	Feature 17 interior	Cheno-am and aggregates
233	Features 8 and 17 exterior	sagebrush, Cheno-am aggregates
329	Feature 29 interior	Insufficient
390	Feature 30 interior	Insufficient
391	Features 28, 29, 30 exterior	Insufficient

latter possibility, it seems likely that the occupants would have taken advantage of its very presence on the site considering the economic importance of the plant to historic populations in the area (Yanovsky 1936). Grass seeds also may have been exploited and processed in the pit structure, or the stems and leaves may have been used to cover the floor. Sagebrush may have been used to construct a shelter over the pit or at least as fuel in the hearths and roasting pits.

Summary

Component 3 represents an occupation that occurred about 1200 years ago during the early part of the Late Prehistoric period. Three activity areas were defined within the excavation block and a fourth was exposed by the pipeline trench. This fourth activity area and one from the block were represented by pit structures and their interior and exterior associations. The two other activity areas were apparently exterior and not directly associated with pit structures. During this occupation, there seems to have been a strong emphasis on processing of wild plant foods as well as animal food resources. The faunal subsistence base primarily exploited large animals, such as bison, for the optimal nutritional value concentrated in the limb bones. Also, smaller animals, such as jackrabbit, were brought to the site as whole carcasses for consumption; and their discarded bones were used to manufacture ornamental objects. Reduction of lithic materials acquired from around the site also was conducted to provide the tools used in subsistence activities. Projectile points are represented by corner-notched varieties resembling the Ruby corner-notched and Rose Spring types of compatible ages in the Late Prehistoric period.

Component 4

Component 4 appeared primarily as scattered flakes and ephemeral, gray-stained soil directly below the bladed right-of-way of the Frontier pipeline. As such, it was originally interpreted as secondary deposition of cultural material from other components disturbed by

pipeline construction. However, profiles in the southwest corner of the excavation block showed a thin, gray-stained stratum (see Figure 12) approximately 20 cm below the original ground surface. This stratum appears to represent this uppermost component, from which no datable materials were recovered. The surface of occupation from Component 4 roughly follows the present ground surface but is shallowly buried in the southwest corner of the block and apparently exposed on the present, bladed surface in the center of the block. More of this component may have been present in upper excavation levels from across the block, but many of these levels were removed without screening the matrix in order to quickly expose the well defined Components 2 and 3.

With the exception of two specimens of bone, lithic debitage was the only form of cultural material recovered from this component (Table 16). This small sample of debitage is composed of ten specimens, representing metaquartzite and authigenic, biogenic, and oolitic chert. The terminal stages of reduction are dominant, comprising 70%, with the remainder representing intermediate decortication stages. With one exception, all of the flakes are less than 2 cm in maximum dimension. The exception is a chunk of shatter that is almost 4 cm in maximum dimension.

The faunal remains are composed of a complete second phalange from a pronghorn and a small (less than 1.5 cm in length) fragment of bone wall from a medium to large mammal. Both pieces are unburned and were found 8 m apart.

No features or fired rock were recorded from this component. Very light, ephemeral, gray-stained sand was noted in the upper levels from which debitage was recovered and in some profiles from just below present ground surface. However, there were no concentrations of this staining to suggest deflated or nearby features.

The minimal evidence from Component 4 prohibits interpretations of the cultural activity during this occupation. Its location directly below the present ground surface and within the bladed right-of-way for Frontier pipeline may have resulted in its disturbance by natural erosion and recent construction. Some of the debitage and bone actually

Table 16. Summary of lithic debitage from Component 4 at the Buffalo Hump site.

Reduction Stage	Raw Material				Total
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Meta- quartzite	
Secondary flake	-	-	1	-	1
Secondary microflake	1	-	-	-	1
Tertiary flake	2	1	-	-	3
Tertiary microflake	1	-	-	1	2
Tertiary flake fragment	1	-	-	1	2
Shatter/Chunk	-	1	-	-	1
Total	5	2	1	2	10

may have been redeposited by Frontier pipeline construction from Component 3, which is located as little as 30 cm below the ground surface in the nearby pipeline trench (Brechtel et al. 1984:140). The greatest concentration of debitage was recovered from the Frontier right-of-way surface adjacent to and downhill from Feature 8 in Component 3, suggesting that it may have been redeposited. However, the stratigraphy indicates that an uppermost, recent, ephemeral cultural component is present above Component 3 (post-1200 years B.P.).

CHAPTER FIVE · INTERPRETATIONS

CONTRIBUTIONS TO RESEARCH THEMES

The research orientation of this data recovery program addressed questions from two analytical levels: site-specific and regional. As discussed in Chapter 1 of this report, the site-specific questions focused on the definition of cultural components and associated activity areas to produce a chronology and investigate functions and dynamic relationships within and between the activity areas in each component. Given these site-specific interpretations, regional research themes may then be considered through comparisons with chronologies, models of subsistence and settlement, and paleoenvironmental reconstructions proposed for the region. The interpretations of the data from the Buffalo Hump site are incorporated with a discussion of their implications for the research themes. These are organized from specific to general in a manner similar to the analytical and interpretive order.

Site-specific Interpretations

This research theme focuses on a detailed examination of data from activity areas in the different components in order to interpret the functions of the activity areas and, ultimately, to derive the reasons for occupation of the site and the dynamics of the activities that occurred. In Chapter 4, the components and activity areas were defined on the basis of visible associations and concentrations in the vertical and horizontal distribution of cultural remains. In this section, the functions of the activity areas are examined with consideration of distributional details and analogies with modern groups of hunters and gatherers. Some of the data from the Buffalo Hump site are particularly suited for this type of analysis because of the diversity of the types of cultural remains and the high degree of integrity of the deposits from which they were documented. Although this is not applicable to Components 1 and 4, from which minimal data were recovered in poorly preserved contexts, the data from the Late Prehistoric Components 2 and 3 provide detailed information appropriate for investigation of function.

Initially, the data are examined with consideration of the model of hypothesized activity area types proposed by Creasman et al. (1985). This model provides a general framework from which to expand into greater detail. The model is illustrated in Table 17 by summarizing the general attributes hypothesized for three ideal types of activity areas. In applying the model to the Buffalo Hump site, three activity areas from each of Components 2 and 3 are examined as well as the combined data from all activity areas in these components. The six activity areas are defined and illustrated in Chapter 4 under the descriptions of Components 2 and 3. Table 18 presents the relevant data from the Buffalo Hump site in relation to the hypothesized attributes from the model of activity area types.

Generally, the Buffalo Hump data correlate most consistently with attributes of the floral processing activity area type but with evidence of the residential type also apparent. The presence of pit structures in Activity Areas A and B from Component 2 and Activity Area A in Component 3 is considered to be evidence of residential occupation, so a closer correlation to the residential type might be expected. However, the residential occupation may have emphasized acquisition and/or

Table 17. Summary of hypothetical attributes of model activity area types from Creasman et al. 1985.

Hypothesized Attributes	Floral Processing	Faunal Processing	Residential
1. Hearths	+	+	+
2. Anvil, hammerstone, fleshing tool, and/or cleaver/chopper	-	+	-
3. Groundstone	+	-	+
4. Positive results from pollen wash of groundstone	+	NA	+
5. Economic plant remains from features	+	-	+
6. Plant remains from occupation floor: Similar to that from features Same as background pollen rain	+	-	+
7. Index of groundstone to flaked lithic tools	greater than 10.0	less than 2.0	2.0 - 10.0
8. Faunal remains consist of: Number of economic species represented	2 or less small to medium and 1 or less large species	more than 1 large species	total of 3 or more species
9. Percentage of skeletal remains from large game species	less than 20%	greater than 50%	20% - 50%
10. Large game bone elements represent butchering units	-	-	+
11. Bone elements crushed and broken	-	+	-
12. Flaked lithic debitage constituents: Primary Flakes Secondary Flakes Tertiary Flakes Tertiary microflakes and submicroflakes Other types	less than 5% less than 5% less than 50% less than 40% less than 5%	less than 5% less than 5% less than 50% less than 40% less than 5%	2% 10% 60% 24% 4%
13. Diversity of flaked lithic tool types	low	higher	highest
14. Patterned distribution of cultural material	+	+	+

Key: + = presence
- = absence
NA = not applicable

Table 18. Summary of data relevant to hypothetical attributes of model activity area types, Buffalo Hump site.

Hypothesized Attributes:	COMPONENT 2		Activity Areas			COMPONENT 3		Activity Areas		
	ALL		A	B	C	ALL		A	B	C
1. Hearths	+		+	+	+	+		+	+	+
2. Anvil, hammerstone, fleshing tool, and/or cleaver/chopper	-		-	-	-	-		-	-	-
3. Groundstone	+		+	+	+	+		+	+	+
4. Positive results from pollen wash of groundstone	+		+	NA	NA	NA		NA	NA	NA
5. Economic plant remains from features	+		+	+	+	+		+	+	+
6. Are the economic plant remains from a recognized occupation floor: similar to those from the features? or the same as background pollen rain?	Yes		Yes	Yes	NA	Yes		Yes	NA	NA
	No		No	No	NA	No		No	NA	NA
7. Index of groundstone to flaked lithic tools*	17		33	50	50	40		100	50	50
8. Total number of economic faunal species represented	8		3	5	4	4		3	2	1
9. Percentage of skeletal remains from large animal species:										
Bison	3%		-	2%	1%	2%		1%	1%	-
Pronghorn	1%		-	-	1%	-		-	-	-
Artiodactyl	-		1%	2%	-	-		-	-	-
10. Do large animal remains represent butchering units?	Yes		Yes	Yes	No	Yes		No	No	No
11. Are bone elements crushed and broken?	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes
12. Flaked lithic debitage constituents:*										
Primary Flakes	8%		5%	10%	7%	12%		11%	12%	20%
Secondary Flakes	33%		43%	29%	34%	31%		22%	36%	40%
Tertiary Flakes	27%		25%	29%	21%	27%		34%	22%	16%
Tertiary microflakes and submicroflakes	26%		16%	23%	36%	23%		30%	20%	20%
Other types	7%		11%	9%	2%	7%		4%	10%	4%
13. Index of diversity of flaked lithic tool types	.5		.2	.2	.2	.4		.2	.2	.2

*Total for all component is greater than the sum of the three activity areas because some artifacts were not found in these activity areas.

Key: + = presence
 - = absence
 NA = not applicable

processing of plant foods, which results in the greater correlation with the plant processing type. Overall, the variation in attributes within each of the components and activity areas shows that several types of activities were occurring with variable emphasis in each of the areas. In some cases, data simply were not produced to relate to the attribute, as in Attributes 4 and 6. In other cases, the data do not fit with the idealized quantities of the attributes. This is true for the faunal attributes (8-11), in which a number of factors influenced the results. In Attributes 9 and 10, the extremely low percentages of skeletal remains, and in some cases the absence of butchering units, are directly related to the nature of the faunal sample and the analytical methods applied to it. The extremely fragmented nature of the faunal sample reduced the potential for identified elements and animals, thereby decreasing the amount of relevant, quantified data and adding an attribute of the faunal processing type (Attribute 11). In Attribute 12, the unusual proportions of the debitage constituents are probably a result of the characteristics of the source materials, which are relatively small and produce greater amounts of decortication flakes as well as small flakes. This kind of variation in the data base is not accounted for in an idealized model. In the case of Attribute 13, the model offered no quantified criteria so that the indices cannot be evaluated in a meaningful way. Attribute 14 in Table 17 does not appear in Table 18 because the six defined activity areas indicate that the cultural material occurred in patterned distributions.

The data from the Buffalo Hump site show some of the inadequacies and inaccuracies of the model of activity area types defined by Creasman et al. (1985). These problems may be explained by a number of reasons. One is that the model was formulated from an insufficient data base in which little data were available from too few sites to provide accurate indices. This problem may be easily resolved by incorporating the greater amounts of data that are presently available to refine the quantifiable indices and attributes. Another problem is the way the analytical methods relate to the criteria required by the attributes, as exemplified in the faunal attributes. The solution may require new definitions of quantified attributes that are more compatible with the demands of analytical methods and variables. The ultimate problem relates to the nature of an idealized model, which simply cannot account for the degree of dynamic variation in the human behavior that produces the cultural remains with which archaeologists must deal. Although floral processing is generally indicated in the data, the variation of attributes in each component and each activity area suggests that a number of activities occurred at one time, with variable emphasis on any one type of activity.

If the model is perceived as "a tentative ideational structure used as a testing device," as defined in *The American Heritage Dictionary of the English Language* (Morris 1981:843), then by definition, the inferred attributes would not necessarily reflect the reality of any one situation. The attributes of the residential activity area were proposed as a representation of a residential site where no one activity was dominant. The data from the Buffalo Hump site appear to contradict this assumption in that the residential activity areas seem to have been used primarily for collection and processing of seeds. Consideration of the relevant ethnographic studies points out similar problems which complicate the applicability of the model to sites such as Buffalo Hump.

In his studies of the !Kung Bushmen, Yellen (1977) emphasizes that most activities take place around the family hearth and specialized activity areas are seldom created. This results in poor archaeological visibility of discrete types. On the other hand, Binford (1983) notes that in Eskimo residential sites, specialized activity areas are created, and these do have good archaeological visibility. The differences may be conditioned by the level, methods, or degree of subsistence orientation. In a foraging subsistence strategy like that of the !Kung Bushmen, residential sites may be used for the full range of activities, whereas a gatherer or collector economy, as reflected in the Eskimo, tends to create a broader range of specialized sites representing specialized activities. One of the problems in relating the Buffalo Hump data to the activity area model may lie in the distinction of forager and collector economies. In order to investigate the full range of activities and the human dynamics that were involved, it is necessary to exercise greater discrimination in distributional analysis of the data and to introduce analogies from ethnoarchaeological studies of modern hunters and gatherers, such as those of Binford (1978, 1983) and Yellen (1977).

In the following discussion, Components 2 and 3 and two activity areas from each of them are examined with primary attention to the nature and distribution of cultural remains in order to interpret functions, or ranges of functions. In doing so, reference is made to some of the concepts of interpreting site structure proposed by Binford (1983:144-192) and Yellen (1977:77-97), whose theories incorporate modern analogies.

Component 2

Component 2 was composed of three activity areas documented in the excavation block and defined by fairly discrete concentrations of features; fired rock; flaked lithic tools and debitage; bone tools and ornaments; fragments of groundstone; and fragmented bone from bison, pronghorn, canid, bobcat, badger, jackrabbit, rodent, and bird. Thousands of charred seeds were recovered from the features in this component. Figure 39 shows the areas defined as Activity Areas A, B, and C with locations of the associated features, artifacts, and in situ fired rock. In Figure 40, the results of trend surface analysis are illustrated for three classes of cultural remains recovered as lots from 1 m² units: lithic debitage, faunal remains, and fired rock. In this last class, it was necessary to show the distribution of the rocks from lots, in addition to those plotted from in situ contexts, because the extremely friable nature of the sandstone produced a large proportion of tiny fragments that were recovered from screens. Although the plotted rocks reflect the overall patterns of distribution, the trend surface analysis of those from lots serves to augment the concentrations.

Consideration of the complete occupational surface of Component 2 shows some general patterns in the distribution of the cultural remains. One of the most obvious patterns is that all classes of cultural materials cluster around features. Moreover, the concentrations of fired rock, debitage, and fragmented bone are situated downwind from the closest feature, or groups of features, regardless of the type of feature. Conversely, the upwind sides of features tend to be relatively free of cultural debris. This may be a reflection of the work space and disposal patterns associated with hearth features. The person

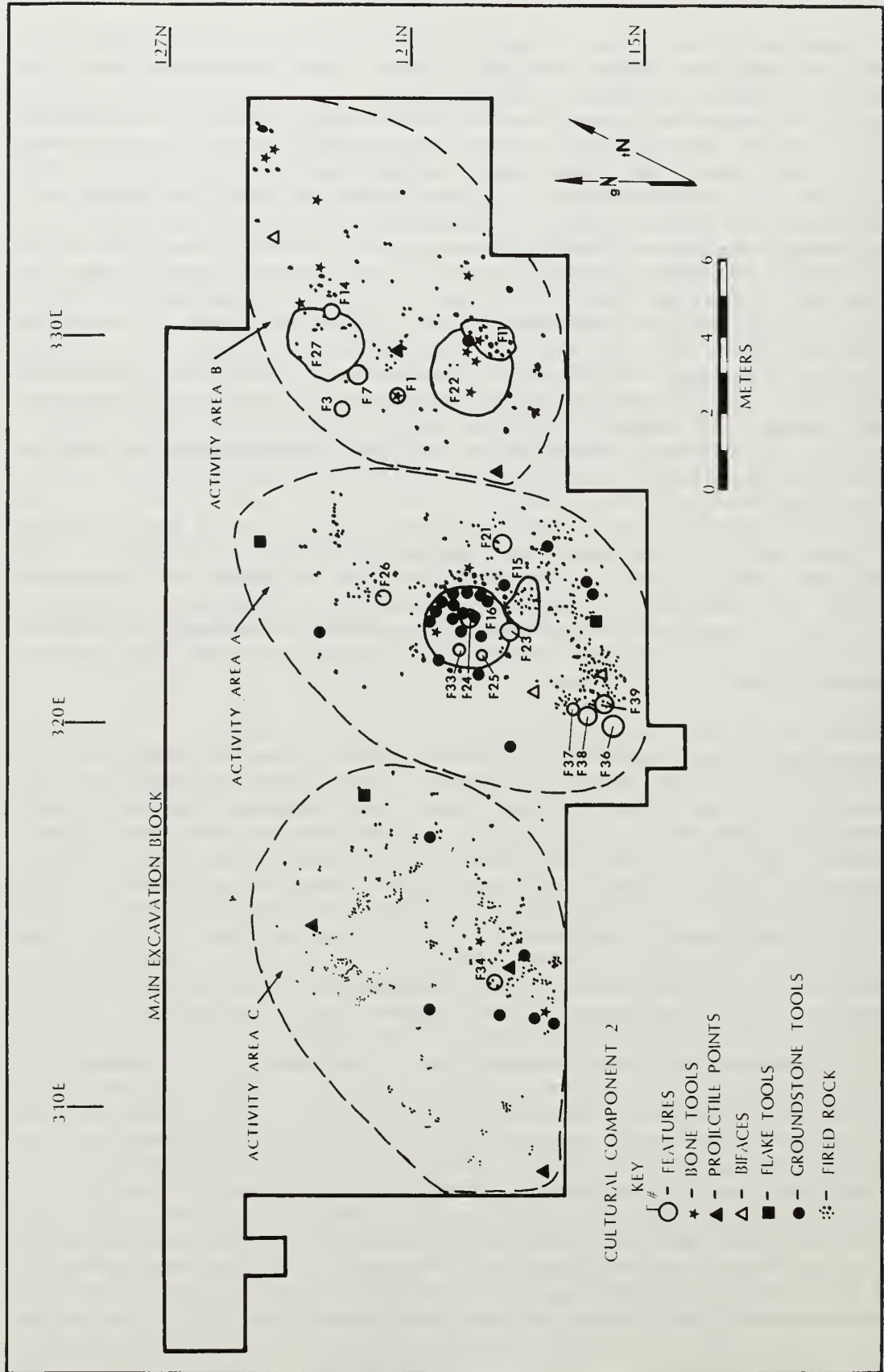
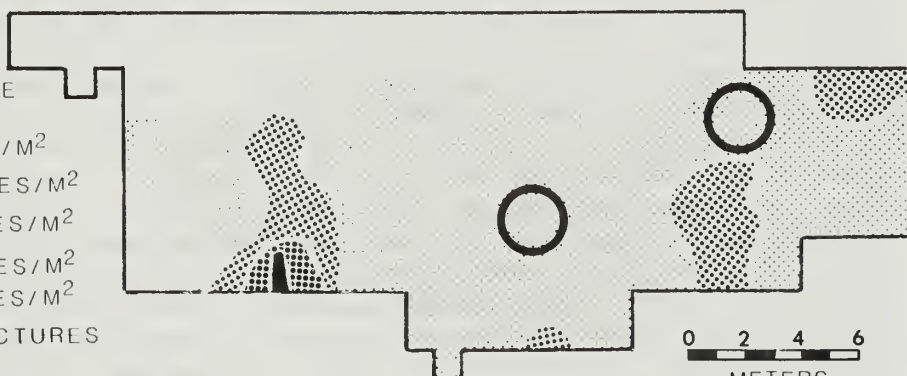


Figure 39. Plan map of the excavation block showing the distribution of plotted cultural remains from the three activity areas in Component 2 at the Buffalo Hump site.

TREND SURFACE ANALYSIS CULTURAL COMPONENT 2

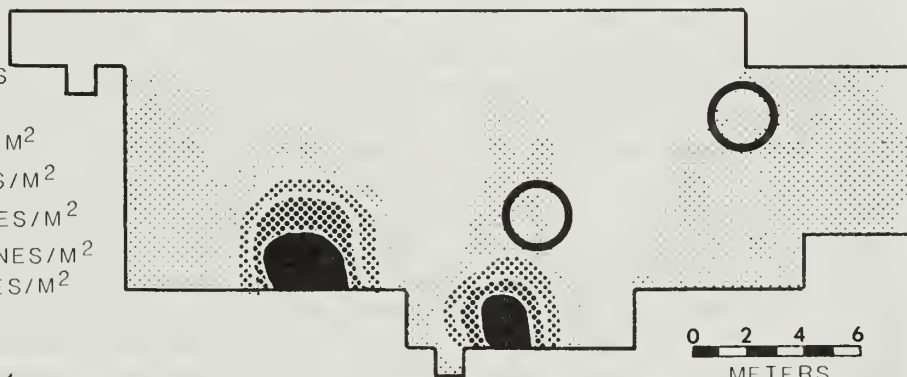
LITHIC DEBATAGE KEY

- -0 FLAKES/M²
- ▤ -1-2 FLAKES/M²
- ▥ -3-4 FLAKES/M²
- ▦ -5-6 FLAKES/M²
- -7-8 FLAKES/M²
- -PIT STRUCTURES



FAUNAL REMAINS KEY

- -0 BONES/M²
- ▤ -1-4 BONES/M²
- ▥ -5-10 BONES/M²
- ▦ -11-20 BONES/M²
- ->20 BONES/M²



FIRED ROCK KEY

- -0 GRAMS/M²
- ▤ -1-250 GRAMS/M²
- ▥ -250-750 GRAMS/M²
- ▦ -750-1000 GRAMS/M²
- ->1000 GRAMS/M²

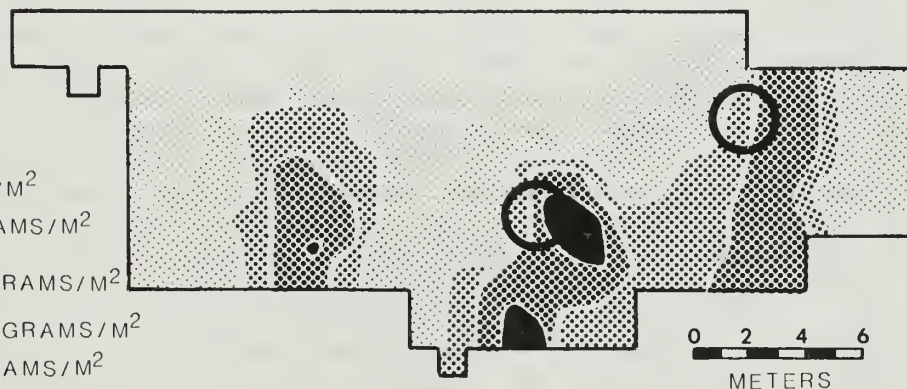


Figure 40. Trend surface distributions per 1 m² of lithic debitage, faunal remains, and fired rock from Component 2, Buffalo Hump site.

performing the work would be more likely to sit upwind from the objective hearth in the smoke-free zone and deposit the debris from that work on the opposite side of the hearth in the area of most dense smoke (Binford 1983:157). Another factor influencing this segregation of debris around hearths is the direction of slope of the ground surface. At Buffalo Hump the gradual downhill slope corresponds to the prevailing downwind direction, a situation which persisted in the past because the depositional history of the site is directly related to prevailing winds. A person working at the hearth would be more likely to toss debris downhill than uphill; in the latter case, the objects would eventually move back down slope into the work space. Regardless of smoke, the debris from cleaning tasks around any kind of feature, including pit structures or shelters, also would be more likely to be thrown downwind and downhill so that the material would not be blown back or roll back into the working and living space.

Although tools, both flaked stone and groundstone, also occurred within the discrete deposits of debris, their distribution was not restricted to the downwind zones. The tools and their fragments tended to be more widely distributed over each activity area, and some were situated within the postulated work space adjacent to hearths. This pattern of tool distribution was most apparent in Activity Areas A and C, where the open space on the upwind side of exterior hearths contained only tools or their fragments. This pattern supports the idea of upwind work spaces and "drop zones" (Binford 1983:153-156), where the tools used to perform activity objectives are deposited on the spot after the work is completed. The wider, random distribution of many of the other tools may reflect a pattern that is roughly analogous to Binford's (1983:153-156) "toss zones," where larger items are removed from the work and living space to alleviate the possibility of discomfort or injury. These randomly distributed artifacts may also mean tools were removed from the work area, reused, and then deposited elsewhere, or there may have been distributional interference caused by children (Yellen 1977: 93).

The spatial interrelationship of the three activity areas shows a relatively uniform pattern. Each area occupies a space with a radius of about 4 m. This uniform distance may be a reflection of a number of factors: (a) the private space or territory recognized by a single, nuclear family unit (Yellen 1977:87); (b) the necessary distance required to segregate simultaneously used work areas in order to minimize interference from smoke and other tasks; (c) the most convenient distance in which people may perform related work activities; and (d) the optimal "toss" capacity of the human body. In these last two possible factors, the common denominator is the human body, which itself is always an important consideration in determining the reasons for spatial distributions of cultural remains (Binford 1983:173).

The limitations imposed by the mechanics of the human body are directly related to the spatial patterning of the "life space" (Binford 1983). At the Buffalo Hump site, the presence of pit structures, or residential units, offers an ideal opportunity to investigate the spatial patterns within confined shelters and compare interior and exterior life spaces. Activity Areas A and B contained residential units and their associated exterior work areas and trash zones, whereas Activity Area C appears to have been an outside processing locus. Activity Area A was chosen for a detailed examination of spatial

distribution within and around a residential unit, and Activity Area C is scrutinized, in contrast, as an outside work space. Activity Area B is not suitable for such a detailed analysis because the excavation of much of this area was negatively influenced by very bad weather conditions, which result in less detailed documentation and poor resolution in spatial distributions.

Activity Area A

Activity Area A is situated between the other two activity areas and was composed of a centrally located house, or shelter (Feature 16), an adjacent, exterior "dump" area (Feature 15); an exterior work area (Features 36, 37, 38, and 39); and two outlying work areas (Features 21 and 26). Figure 41 shows the distribution of the features and associated cultural remains with more detailed and accurate plotting than is possible in the larger scale of Figure 39. The trend surface distribution analysis of the bone debris and the most dense concentration of debitage are superimposed to illustrate the spatial relationships. The plotted in situ fired rock is representative of its distribution; reference to Figure 40 helps to show the more complete, averaged spatial patterns.

Within the shelter, the spatial patterns were influenced by the confined space in relation to the requirements of working and/or living. Whereas the wind factor may be minimized by orienting the shelter's opening away from the prevailing winds, light becomes a primary influence in the orientation of activities (Binford 1983:180). In this structure, the southwestern margin (oriented to grid north) or southern margin (oriented to true north) appears to have been relatively free of debris. This may reflect the orientation of the opening, in which case the wind would be minimized in favor of maximum exposure to sunlight, which tends to be oriented toward the south for much of the year. The location of a hearth or roasting pit (Feature 23). on one side of this hypothesized doorway is consistent with Leroi-Gourhan's model for a residential site (Binford 1983:148, Ill. 81). Also, the orientation of the adjacent midden concentration (Feature 15) is analogous to the pattern documented by Binford at the Clean Lady site (Binford 1983:151, Ill. 85), offering more evidence for the location of an opening in this shelter. The interior space appears to have been organized around a central hearth, or roasting pit (Feature 24), with two small pits (Features 25 and 33) to the side and groundstone fragments and a bone awl distributed primarily toward the wall in back of Feature 24. This pattern suggests that the worker sat somewhere near the center, between the three features, or in the open space, grid north of Feature 24, where light from the opening would have been maximized.

It is important to note that the three interior features (Features 24, 25, and 33) contained thousands of charred goosefoot seeds, whereas the edge feature (Feature 23) contained only a few. This evidence and the presence of the groundstone fragments argue strongly for a specialized function of this structure as a seed processing locus where shelter from normally strong winds would optimize the amounts of seeds retained from processing. The deep, oxidized, bell-shaped pit (Feature 24) may have served as the centrally located roasting or storage facility with ancillary pits (Features 25 and 33) used for stockpiling or other purposes related to the seed processing. Although among historic Indians seeds were roasted in basketry trays by shaking them

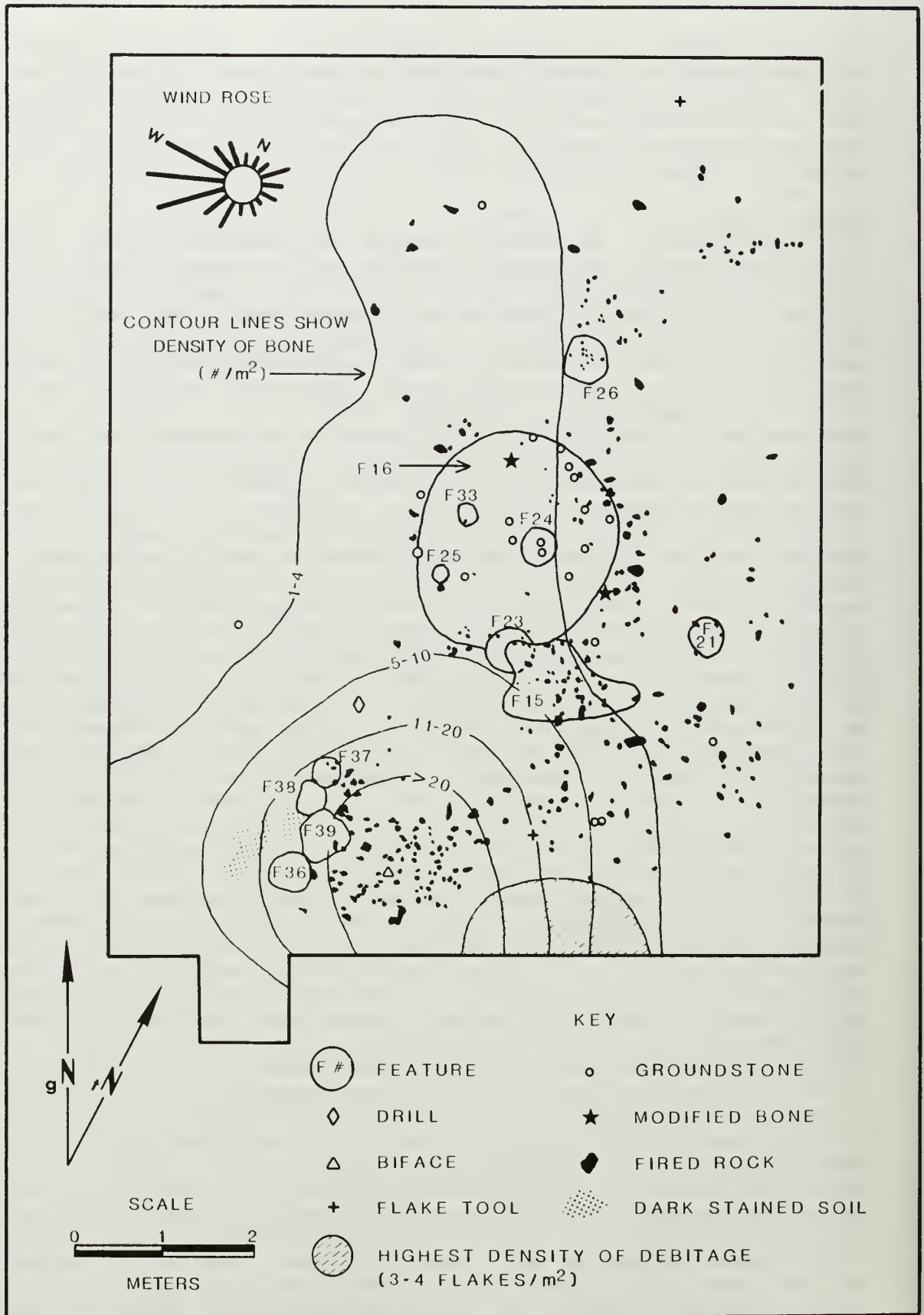


Figure 41. Detailed plan map of Activity Area A in Component 2 at the Buffalo Hump site. The wind rose represents annual frequencies of prevailing wind directions recorded in the BLM Rock Springs District (Department of Interior 1978:R2-16).

among hot coals (Steward 1941:231) rather than placing them, en masse, into roasting pits, it is possible that these pits may have been used to cook cakes (Palmer 1871:419) made from ground seeds. Many seeds have remained whole and dropped into the ashes. Also, long-term storage of whole seeds was common (Kelly 1932:98). The other deep, bell-shaped pit (Feature 23) on the edge, in the opening, may also have been used to roast meal cakes or store seeds. The greater numbers of charred seeds in the interior features may be a result of accidental fallout that occurred during retrieval of seeds from the features; more seeds would tend to be deposited in place within the shelter whereas wind may have carried away seeds dropped while cleaning out the pit in the doorway. The strong evidence for seed processing and the limited amount of space within this shelter decrease the likelihood of its use as a house and sleeping facility. The evidence suggests it was a specialized shelter for seed processing. If the evidence in the large quantities of seeds is viewed as indicating occupation during the warmer months, then sheltered sleeping quarters would not necessarily have been required or even preferred.

The construction of the shelter appears to have entailed the excavation of a shallow pit over which a light brush superstructure was built. It is possible that the shallow pit may have been the result of extensive use, in which continual trampling and cleaning produced the depression. However, the circular alignment of rocks around its margin was vertically situated well above the defined floor. This may be evidence of an excavated pit and superstructure, around which the removed soil was piled. Subsequent outside activity may have resulted in the deposition of fired rock on top of the exterior ring of piled soil. If the superstructure was constructed of the low bushes available in the immediate vicinity of the site, the excavation of a shallow pit would have increased the interior vertical space by alleviating the structural problems involved with the use of small brush. The higher frequencies of sagebrush pollen from the structure floor and from samples taken from the leeward side of the shelter may be evidence of the use of sagebrush as the primary constituent in the superstructure.

Outside the shelter and in front of the proposed doorway, an exterior activity area composed of four shallow pits, or basins, was situated 2 m from the shelter. The intervening space was relatively free of cultural debris and may represent a cleared pathway used to gain access to interior and exterior work areas in simultaneous use. Binford (1983:173-176) observed a similar pattern in four different hunter-gatherer groups (!Kung Bushman, Nunamiut Eskimo, Ngatatjara Aborigines, and Blackfoot American Indians) in which cooking or "kitchen" hearths were located outside houses or shelters a few feet from the doorways. This configuration leaves the sheltered living space free of the smoke and trash produced from cooking meals while, at the same time, creating a working area in close enough proximity to facilitate movement and communication between the two areas. The four hearths in this external "kitchen" in Activity Area A may have been used at the same time in conjunction with processing bone juice or grease, or they may represent several events of extracting these nutrients. The latter hypothesis may be a more plausible explanation because some of the basins appeared to have been excavated into others. Extraction of bone juice may have required the use of two basins, one to serve as a hearth to heat stones to be placed in a nearby, lined boiling pit.

Given this hypothesis, the four features may represent two processing events, the larger basins (Features 36 and 39) being the hearths and the smaller ones (Features 37 and 38) being lined boiling pits. The dark-stained soil to the west may reflect the remains of cleaning out the hearths (scrapping toward the worker) to retrieve the heated rocks, which were tossed downwind of the hearths and work space after being used as was the other refuse from processing. The density of fragmented bone debris coincides with the rock dump in a pattern that reflects this process. This kitchen area may not have been used for such a specialized purpose as bone processing but, rather, as a generalized cooking facility to prepare daily meals. The minor amounts of seeds from these features may be a reflection of the vegetal constituent in the meals, and the bone debris may represent the remains of the meat portion. The number and configuration of the hearth features suggest continual use of the kitchen area, in which a number of meals were prepared using new hearths as others became too disordered and undesirable for reuse (Binford 1983:159).

As is commonly the case, other related activities occurred in the same area, as evidenced here by the low density concentration of debitage to the east of the bone and rock dump. The expedient flake tool and biface blank fragment in the trash may represent the remains of lithic tool manufacture that took place nearby (perhaps outside the excavated area) but at a different time from the bone processing because of the location in the smoke zone.

The outlying features (Features 21 and 26) probably represent areas of less intensive use. The fact that both were unoxidized basins may indicate their short-term use as hearths, in which case their placement at a distance from the shelter would have reduced the potential for igniting the brush superstructure. A possible function of these features may have been related to hide working, which Binford (1983:172) observed to be practiced commonly in "areas peripheral to the central parts of residential camps . . . just to the side of or slightly behind shelters." However, lacking any evidence of hide working, another possibility is suggested in the presence of charred seeds. Both these features contained large amounts of charred seeds, suggesting their use in conjunction with seed processing. These may simply be exterior seed processing loci that were used when weather conditions were favorable. The use of Feature 21 may have taken advantage of the windbreak provided by the shelter.

Activity Area C

Activity Area C was composed of a single small, basin-shaped pit (Feature 34) and the associated cultural debris (Figure 42). The cultural remains were segregated around the feature into a downwind dump zone and an upwind, trash-free work area. The isolated occurrence of this small, unoxidized pit is somewhat unusual given the diversity of the fairly large amounts of cultural debris around it. Generally, features at the Buffalo Hump site occurred in groups, with several types represented, some of which appear to have been hearths based on their size, shape, and presence of oxidation. Although Feature 34 shows none of the characteristics of hearth features, some of the surrounding cultural remains indicate the presence of a nearby hearth, which could be located outside the excavated area or may have been placed on the unprepared ground surface, leaving little evidence. However, the

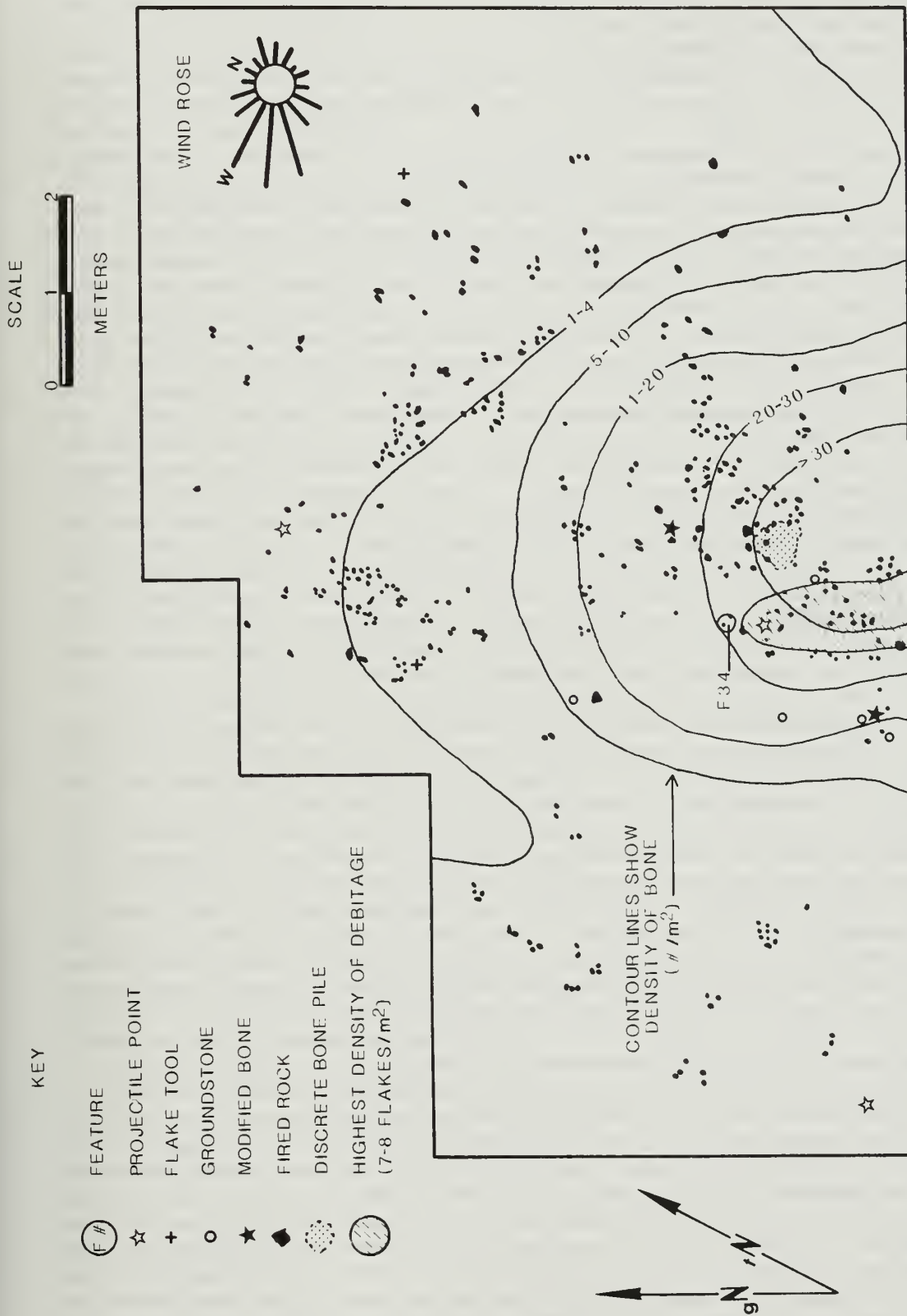


Figure 42. Detailed plan map of Activity Area C in Component 2 at the Buffalo Hump site.

distribution of cultural debris appears to be centered around Feature 34, suggesting that it may have served as the hearth or that a surface hearth was immediately adjacent.

A number of different activities are represented in the associated cultural remains. Processing of animal bone is indicated in the concentration of fragmented elements and fired rock in the smoke zone to the east of the feature. Within the larger concentration was a discrete pile of small bone fragments, reflecting a pattern similar to the "small bone juice dump" recorded by Binford (1983:154) at an Anaktiqtau kill site. At this modern context, a "quick flaming fire was kindled" over which a coffee can was suspended for boiling broth. Once the broth was produced and consumed, the remaining bone fragments were tossed across the fire on one side. In Activity Area C, the pile of bone fragments was situated across the hearth from the working area, as if the worker had tossed the contents of a container over the fire and away from him. Another activity is represented in the concentration of debitage from which a small base fragment of a projectile point was recovered. The location of the debitage concentration suggests that the worker, or another individual, sat upwind from the hearth and knapped stone, possibly to produce a projectile point which broke during manufacture and was discarded with the debitage. A third activity is represented by the fragments of groundstone around the margins of the work area and the charred seeds recovered from within the feature. Although the small amount of charred seeds does not reflect the intensity of plant processing apparent in Activity Area A, these remains indicate that plant processing may have occurred in this area along with bone processing and lithic reduction. The seeds and bone debris may represent the remains of the preparation of daily meals in a pattern similar to the kitchen area in Activity Area A.

Additional kinds of concurrent activities may be indicated by other remains. The bone tube found to the south of the feature suggests that ornaments may have been manufactured from the bone fragments in the refuse pile, although no further evidence of this kind of activity was recovered. A complete, sturdy bone awl made from a shaft fragment of a pronghorn metatarsal was recovered from 1 m northeast of Feature 34. This may reflect basket manufacture or maintenance or, possibly, hide working. More evidence of the latter may be indicated by the circular, 2 m diameter void in the rocks to the north. Binford (1983:172) noted that a peripheral area designated for hide working commonly had stones cleared away to create a clean space for the hide to be processed; this produced a "ring" of stones, some of which may have been used to weigh down the margins of the hide. Another explanation for this clear, circular area is that it represents the remains of a surface enclosure. As noted in the discussion of the pit structure in Activity Area A, rocks appeared to have been deposited around the margins of the shelter, against the supposed walls, as a result of site use. This pattern may be repeated in Activity Area C, where a low shelter may have been placed on the unprepared ground surface. The overall distributional pattern of cultural remains is almost identical to that of Activity Area A: an open space ("doorway"?) in the circle of rocks was situated on the southwestern margin (oriented to grid north) and a cleared "pathway" was apparent between this and the work area at Feature 34, which, itself, is located at a similar distance and orientation as is seen in the kitchen area and shelter in Activity Area A. The absence of an

excavated pit and interior features may reflect a different function for this possible "shelter." In this case, a small brush "lean-to," or enclosure, may have been constructed on the surface to provide shade and shelter from the wind for the worker(s) engaged in the activities centered around Feature 34. This pattern was observed among the "Yellow Bushmen" in Angola (Binford 1983:173).

Component 3

Four activity areas were documented from Component 3: Activity Areas A, B, and C in the excavation block and Activity Area D from the monitor of the pipeline trench. Activity Areas A and D were composed of pit structures and their associated interior and exterior features, whereas Activity Areas B and C represent groups of features in exterior contexts. Concentrations of cultural remains from these activity areas were composed of fired rock; flaked lithic tools and debitage; bone and shell tools and ornaments; fragments of groundstone; and fragmented bone debris from bison, canid, jackrabbit, and rodent. Hundreds of charred seeds were recovered from a number of features, primarily from Activity Area A within the pit structure. Figure 43 depicts the areas defined as Activity Areas A, B, and C and shows the features, artifacts, and in situ fired rock. Activity Area D, located about 15 m southwest of Activity Area C, is not illustrated and discussed because of the different context of investigation, which resulted in the recovery of very limited amounts of data. Figure 44 shows the results of trend surface analysis for flaked lithic debitage, faunal remains, and fired rock recovered as lots from 1 m² units. The patterns revealed in the trend surface analyses of these remains from lots augment the distribution patterns apparent in the plotted in situ remains.

As in Component 2, some general patterns can be seen in the distribution of cultural remains over the entire occupational surface within the excavation block. The cultural material clustered around features and tended to be distributed predominantly downwind and downhill from the closest associated features. The upwind, uphill sides of features tended to be relatively free of cultural debris, a pattern which may reflect the work space associated with the features. The downwind concentrations of cultural debris are suggestive of toss zones (Binford 1983:153) where refuse from activities is removed from the work area and deposited in the smoke zone. Many of the tools (flaked stone, groundstone, and bone) were located in and around the open work spaces in Activity Areas A and B. This may be a reflection of drop zones (Binford 1983:153), where implements used in and/or produced from activities are deposited nearest to the locus of work.

Like Component 2, the activity areas were defined by concentrations of cultural remains distributed within an area roughly 4 m in radius. This pattern is most obvious in Activity Area B, which appears to have been excavated in its entirety. Activity Area C was partially excavated, and in the case of Activity Area A, the northern portion was removed previously by the Frontier pipeline and the extended eastern portion appears to represent an exception to the pattern. The fairly constant pattern of areal extent in these activity areas is probably a result of the mechanical capacities and requirements of the human body and the tasks it performs. Proximities of cultural remains within the activity areas may be dictated primarily by capacities of body mechanics, whereas distance between centers of activity would be

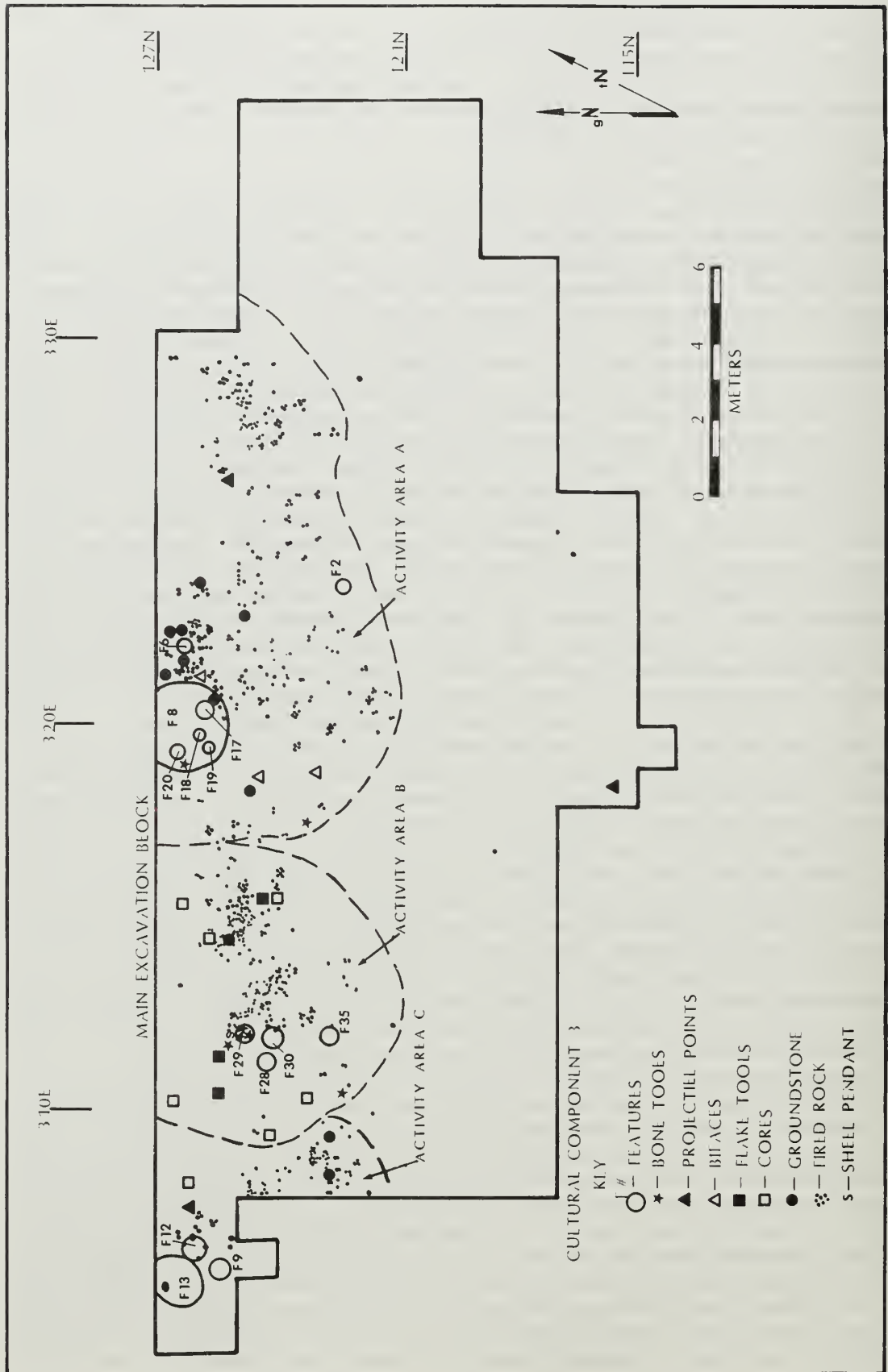


Figure 43. Plan map of the excavation block showing the distributions of plotted cultural remains from three activity areas in Component 3 at the Buffalo Hump site.

TREND SURFACE ANALYSIS CULTURAL COMPONENT 3

LITHIC DEBITAGE KEY

- - 0 FLAKES/M²
- ▤ - 1-2 FLAKES/M²
- ▥ - 3-4 FLAKES/M²
- ▦ - 5-6 FLAKES/M²
- - 7-9 FLAKES/M²
- - PIT STRUCTURE

0 2 4 6
METERS

FAUNAL REMAINS KEY

- - 0 BONE/M²
- ▤ - 1-4 BONES/M²
- ▥ - 5-10 BONES/M²
- ▦ - 11-20 BONES/M²
- - > 20 BONES/M²

0 2 4 6
METERS



FIRED ROCK KEY

- - 0 GRAMS/M²
- ▤ - 1-250 GRAMS/M²
- ▥ - 250-750 GRAMS/M²
- ▦ - 750-1000 GRAMS/M²
- - > 1000 GRAMS/M²

0 2 4 6
METERS

Figure 44. Trend surface distributions per 1 m² of lithic debitage, faunal remains, and fired rock from Component 3 at the Buffalo Hump site.

governed by factors such as interference with and communications between simultaneously occurring activities.

Two of the activity areas in Component 3 were examined in detail for functional interpretations evident in the types and distribution of cultural remains. Activity Area A is considered an example of a residential unit with its associated external work areas. Activity Area B was chosen as an outside locus of work entirely exterior to a residential unit. Activity Areas C and D were not suitable for such a detailed examination because of the limited data recovery due to incomplete excavation.

Activity Area A

Activity Area A was the largest and easternmost of the four activity areas (Figure 45). It was composed of a pit structure (Feature 8) and its four interior features, an adjacent work area (Feature 6), and an outlying work area (Feature 2). The northern portion of this activity area and the northern edge and center of the pit structure were removed previously by investigations associated with the Frontier pipeline (Brechtel et al. 1984). The remainder of the area documented in the excavation block shows a number of similarities to the patterns seen in the "residential" Activity Area A from Component 2.

Within the pit structure, or shelter, much of the floor space was occupied by pit and basin features, leaving little room for work and/or sleeping space. Open areas were present to the north and west of Feature 17 and between it and the other features where a worker may have sat to perform tasks in which all features were related. The tasks probably involved seed processing, as evidenced by the abundance of charred seeds from the interior features. Hundreds of charred seeds, primarily goosefoot, were recovered from the large, oxidized bell-shaped pit (Feature 17), and significant amounts of the same type of seed were retrieved from the three other interior features as well as from the floor of the structure. The evidence is similar to that from the pit structure in Activity Area A from Component 2 where thousands of charred goosefoot seeds were recovered from the central bell-shaped pit, the interior ancillary pits, and the floor. The interior bell-shaped pits may have been used to store and/or roast seeds, meal cakes, or other plant parts, and the smaller basins may have been used as auxiliary storage, for stockpiling, as roasting facilities, or for some other purpose related to preparation of seeds for consumption or storage. Although only one fragment of groundstone was recovered from within this structure, others were found outside and nearby, and additional pieces may have been present in the fired rock documented from the PEC test unit (Brechtel et al. 1984:144). As in the case of the structure in Component 2, the evidence of seed or plant processing and the limited interior open space suggests that this structure may have been a specialized shelter constructed for seed processing rather than for habitation.

The patterns of construction and use of this structure may have been very similar to those proposed for the structure in Component 2. An entryway or opening in the shelter may have been located in the southern or western margin where adjacent, exterior cultural debris was absent. It is more likely that the opening would have been oriented to the south in a pattern similar to the structure in Component 2 because an opening to the west, or windward, would defeat the purpose of a shelter. Although a nearby, outside kitchen area is absent, a rock-free

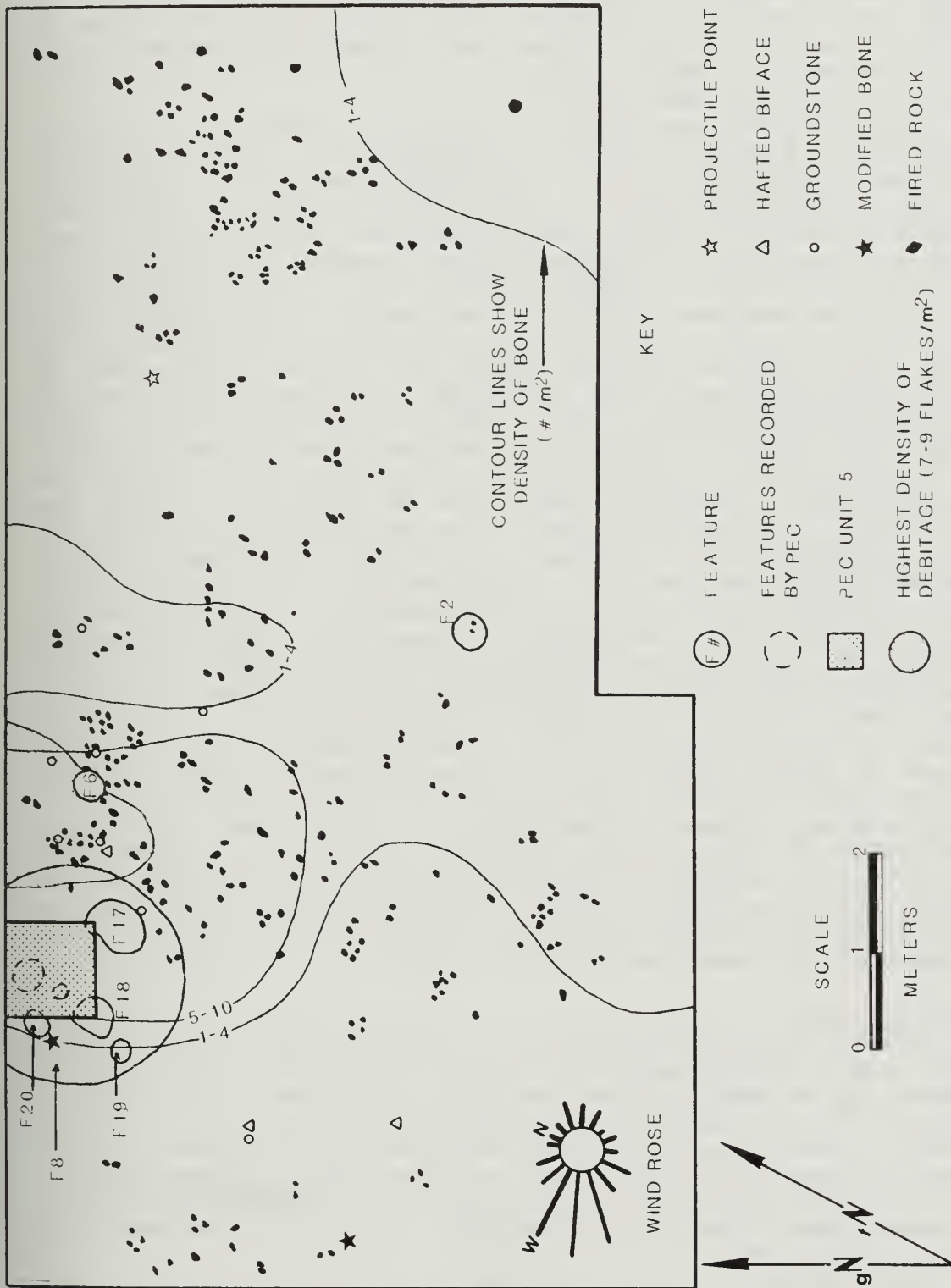


Figure 45. Detailed plan map of Activity Area A in Component 3 at the Buffalo Hump site.

pathway was apparent to the south-southwest of the shelter where a mano fragment and two hafted bifaces were recovered in what may be viewed as a drop zone (Binford 1983). The most dense concentrations of cultural refuse were situated to the east, southeast, and south of the shelter in downwind, downhill contexts. These may represent the shelter's toss zones (Binford 1983), where refuse from cleaning activities from within the shelter may have been deposited.

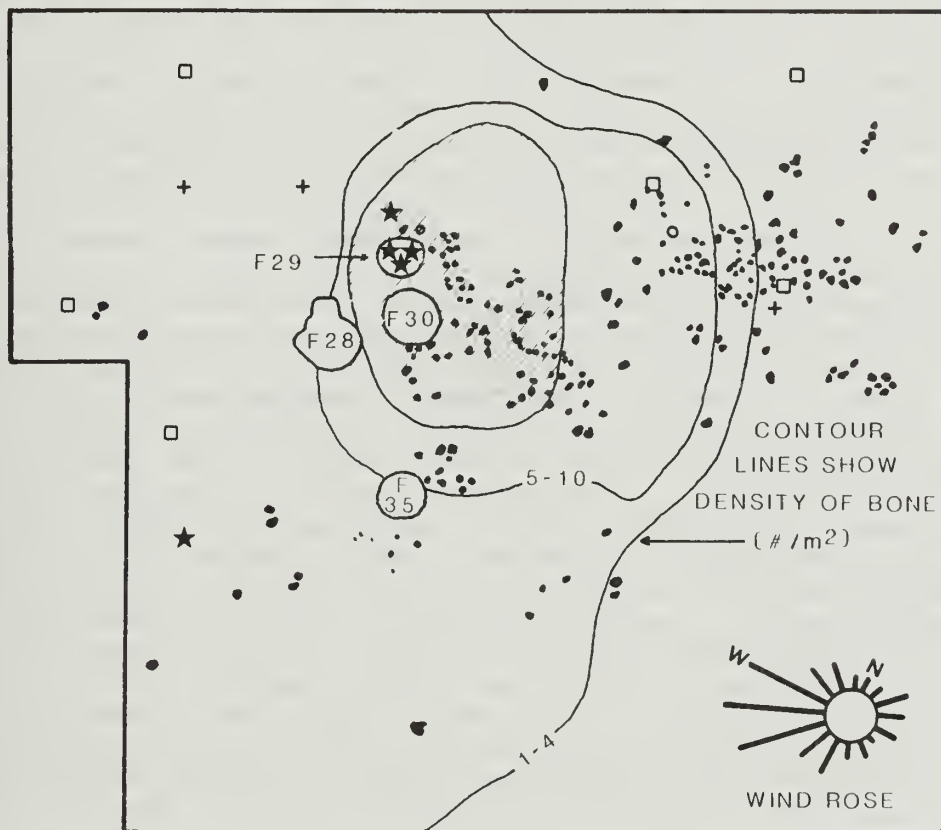
Directly to the east of the structure, an outside work area was represented by a small, unoxidized, basin-shaped pit (Feature 6) and its associated cultural material. The concentration of groundstone fragments around this feature and the number of charred goosefoot seeds from within the pit indicate that this may have been an exterior seed processing area. Its location nearby and downwind from the structure would have provided the worker(s) shelter from prevailing winds. The work space may have been directly to the north of the small pit, where fired rock is absent. Another type of activity is represented in the concentration of lithic debitage around this feature. The worker, or another individual, may have sat nearby and knapped chert, or the concentration of flakes may simply have been deposited with the other refuse. The absence of data to the north limits the interpretive value.

Farther away and to the southeast another work area is represented by another small, unoxidized, basin-shaped pit (Feature 2). Other than a few pieces of fired rock from within the pit and scattered some distance to the west and northeast, no cultural remains were recovered from within and around the pit. Lacking evidence of cultural activity, functional interpretations are not substantiated. It is possible that the pit may have been used simply as a hearth for warmth or that its function was related to some type of activity from which identifiable remains were not produced or preserved. Another portion of Activity Area A that is difficult to explain is the concentration of fired rock in the eastern portion of the area. This area does not conform to the pattern in which fired rock is closely associated with cultural features. This fired rock may represent an outlying dump area for the pit structure, although concentrations of other types of cultural remains might be expected if this were the case. It is possible that the rocks were associated with another activity area or work area located outside the excavation block. Indeed, this may be the case, as evidenced by the number of features recorded by PEC to the north and northeast of this area (Brechtel et al. 1984).

Activity Area B

Activity Area B was composed of a cluster of three features and a fourth feature located nearby to the south (Figure 46). Three types of medium-sized features were represented: an oxidized, bell-shaped pit (Feature 30); an oxidized, basin-shaped pit (Feature 29); and two unoxidized, basin-shaped pits (Features 28 and 35). Associated cultural remains included fired rock; lithic debitage; cores; expedient tools; a bone awl; several bone ornaments; a mussel shell pendant fragment; and fragmented bones from bison, jackrabbit, and unidentified mammals of similar sizes.

The distribution of cultural remains conforms to the typical patterns. The downwind, downhill sides of the features contained the most dense concentrations of fired rock, and the debitage and bone debris were concentrated around the cluster of features, offset slightly to the



KEY



Figure 46. Detailed plan map of Activity Area B in Component 3 at the Buffalo Hump site.

downwind side. A segregated concentration of fired rock and artifacts to the east of the feature cluster may represent a designated dump area removed from the center of activity around the features. These refuse concentrations may reflect the forward toss zone (Binford 1983:153) associated with the features. In contrast, refuse is markedly absent from the upwind, uphill sides of the features, from which only expedient tools and cores were recovered. These areas may be viewed as the work space, and the artifacts as representative of the drop zone. The cores situated around the upwind margin may represent the backward toss zone (Binford 1983:153) into which workers tossed larger, discrete items to remove them from the work space.

The number and configuration of the hearth or pit features may be indicative of continual use of this activity area over a period of time rather than simultaneous use of all four features for one activity or related tasks. In outside work areas, workers are easily able to change their position in relation to the hearth if the wind direction shifts or abandon one hearth and create another slightly offset from the former (Binford 1983:158-159). This movement may also occur as a result of optimal use of one hearth, making it undesirable for further use. This behavioral pattern may be represented best in Feature 35 where an offset hearth may have been used because of a slight shift in wind direction or because the center of activity became too untidy for further use. The lower density of refuse around Feature 35 suggests a shorter term of use than is indicated around the other features. The segregated concentration of debris to the east of the other features may be a reflection of preventative maintenance of the activity area where the waste accumulated from long-term, continuous use was removed from the center of activity to maintain the utility of the work area (Binford 1983:189).

A significant characteristic of this activity area is the abundance of modified bone and shell that was concentrated within and around the oxidized, basin-shaped pit (Feature 29). Three burned and fragmented bone tubes made from long bones of jackrabbit and small mammal were recovered from within this pit, and an awl made from a pronghorn metatarsal shaft and a perforated mussel shell fragment were collected from the northern edge of the pit. A fourth tube made from the humerus of a jackrabbit was located to the southwest of the feature cluster.

These remains suggest that several types of activities occurred near these features. The pits themselves may have been used to process animal bone for production of grease and/or juice. The oxidized pits may have served as hearths to heat rocks, while the unoxidized basins could have functioned as receptacles for the heated rocks to cook the animal resources or as lined boiling pots. The refuse from these rendering activities was then tossed away from the work space and into the smoke zone. Another related activity may have been the manufacture of tools and ornaments from the refuse of bone processing. Although no specimens from early or intermediate stages of manufacture were recovered, the complete, burned and fragmented bone tubes from Feature 29 suggest that ornamental fabrication was a focus of activity. The shell pendant fragment also supports this interpretation. The bone awl may reflect hide working or basket making and maintenance, both of which also may be considered as fabrication activities. Still another type of fabrication or manufacturing activity is indicated by the flaked lithic cores, debitage, and tools. Lithic reduction appears to have been an

important activity here. All stages of the reduction sequence are represented. The number of cores from locally available sources reflects a focus on tool manufacture using raw materials acquired from the site area. Two lithic reduction work areas may be represented in Activity Area B. One was in the work space upwind from the features, and the other may have been near the segregated rock concentration to the east. In the case of the latter, the lithic artifacts may have been deposited with the other refuse from the primary work space near the features.

In contrast to the abundant floral evidence from Activity Area A, the features from Activity Area B yielded very few charred seed remains. Only three goosefoot seeds were recovered from Feature 30, several seeds of unknown species came from Features 29 and 35, and none were found in the fill of Feature 28. Only one small fragment of groundstone was recovered from the segregated concentration of fired rock, and its presence there may be indicative of its use for heat transference rather than for grinding seeds. The minor amounts of charred seeds from the features may represent prehistoric, natural seed rain or accidental introduction from nearby seed collection and processing activities.

Generally, the evidence from Activity Area B suggests that a number of individuals may have been engaged in several different kinds of outdoor activities, primarily involving fabrication or manufacture of tools as well as decorative objects. Subsistence related tasks are evident in the faunal remains, which suggest that skeletal parts of a bison, jackrabbits, and possibly other mammals were rendered for bone juice or grease. In contrast to the heavy emphasis on floral processing in the sheltered context of Activity Area A, little or no emphasis on floral processing is evident in the outdoor work area represented in Activity Area B. The different uses of the two activity areas was dictated by the requirements of the tasks performed in each. The strong prevailing winds in this area would have created a need for a windbreak or shelter in which stockpiled seeds could be processed with a greater rate of retrieval. Conversely, daily meal preparation, faunal processing, and fabrication activities may have been better suited for the out-of-doors because the abundant refuse produced by such tasks could be easily removed from the unconfined work space.

Summary of Activity Area Interpretations

The occupations represented in Components 2 and 3 at the Buffalo Hump site reflect residential habitation by small family groups of hunters and gatherers who occupied the site for a period of time in the late summer and fall for the primary purpose of collecting and processing seeds from wild, indigenous plants such as goosefoot. Although it is possible that several occupations may be represented in each component, the segregation of cultural remains into discrete activity areas indicates single occupations. If each activity area were to represent a different occupation of the site, there would be a greater probability of overlap in the cultural remains of each area. One occupation is indicated by the distinct separation between activity areas, that reflect the manner in which the occupants utilized the space for a number of purposes over a contiguous period of time during the seed collecting season.

In Component 2, two residential activity areas were represented by pit structures, or shelters, and the associated outdoor work areas.

These may reflect the houses and recognized private territories of nuclear families composed of a husband, wife, and immature offspring who shared a dwelling and outdoor kitchen hearths (Yellen 1977:89), engaging in daily tasks, eating, and sleeping in their acknowledged family area. The two adjacent residential areas (Activity Areas A and B) may represent families that were related by affinity or as a larger extended family, based on the pattern recorded by Yellen (1977:89-90) in the !Kung Bushmen where nuclear families of closest relation placed their huts nearest to each other. The evidence of intensive seed collection and processing in the residential Activity Area A suggests that this was the primary locus of such activity, most of which took place indoors where shelter from the strong prevailing winds would have increased the rate of retention of the collected, stockpiled seeds. A similar emphasis on seed gathering and processing is apparent in the adjacent, residential Activity Area B, in which a communal trash dump in its southern portion may have been produced and used by both families (see Figure 39). The fact that most of the bone tubes and residue from their manufacture were recovered from Activity Area B (see Figure 39) may suggest that a member of this family was a craftsman.

Activity Area C may represent an outdoor, public or communal activity area (Yellen 1977:95) where members of one or both families congregated to engage in shared domestic tasks, such as rendering bone juice and grease and manufacturing flaked stone tools or other various crafts. However, the possibility of a surface shelter, or enclosure, in the center of this area presents another likelihood. In his observations of the !Kung Bushmen, Yellen (1977:89) noted that camps were composed primarily of the nuclear family houses, with separate huts occupied by individuals without families, such as young unmarried adult males or elderly widowers. Activity Area C may be a reflection of this kind of residential unit where a rudimentary, surface lean-to may have housed single men who slept in the shelter and cooked and ate daily meals and engaged in a number of activities around the small hearth.

Similar interpretations may be applied to the activity areas in Component 3, although incomplete sampling produced limited evidence. The pit structure and associated exterior work and disposal areas in Activity Area A may represent the dwelling and private territory recognized by a nuclear family unit. Seed gathering, stockpiling, and processing appears to have been emphasized within the sheltered context of the house and outside on the leeward side of the shelter. Activity Area B may have been an outdoor, communal activity area where members of the family who were not engaged in seed collecting and processing may have gathered to carry out other tasks. The tasks involved subsistence related chores, such as rendering bone juice and grease and manufacturing of flaked stone tools, and included craft or fabrication activities focused on the production of ornamental objects. Activity Area C may represent a similar type of activity area, although such an interpretation cannot be substantiated with the partial evidence gathered.

The number of parallels between the quantities, distribution, and types of cultural remains from Components 2 and 3 suggest that the site was occupied by similar cultural groups at two times in the past 1500 years. These groups appear to have been composed of at least one or two nuclear families who camped in the vicinity of Buffalo Hump for a period of time in the late summer or fall to exploit the abundant seed resources available on and near the site. Their dwellings or special

purpose structures were apparently constructed of sagebrush placed over a shallow, circular, excavated depression and used primarily as shelters in which to stockpile and process the collected seeds. The primary source of the seeds was goosefoot plants, which the people may have encouraged to grow in more dense stands through ground disturbance and broadcast sowing.

Regional Research Themes

Three regional research themes were proposed in the project treatment plan (Creasman et al. 1985) and applied to the data from the Buffalo Hump site. The first theme addresses the cultural chronology proposed by Zier et al. (1983) for southwestern Wyoming. The second theme concerns the model of subsistence and seasonal settlement patterns proposed by Sanders et al. (1982). The third major theme is directed at a reconstruction of the paleoenvironmental history of the region, based on the geomorphology and pollen data from a number of sites in the area and how the data from Buffalo Hump fit into the scheme. Each of these themes is discussed below.

Cultural Chronology

The primary emphasis of the cultural chronology research theme is to compare the defined components from Buffalo Hump with the corresponding phases proposed by Zier et al. (1983). The chronology proposed by Zier et al. (1983) defined phases based primarily on frequencies of radiocarbon ages, and gave descriptions of cultural traits derived from the existent data base. Figure 5 in Chapter 2 summarizes this proposed chronology in which the Archaic period is divided into four phases and the Late Prehistoric period into two phases. At the Buffalo Hump site, three of the four defined cultural components produced radiocarbon ages consistent with two of the phases proposed by Zier et al. (1983).

In Component 1, an averaged radiocarbon age of 1800 ± 79 years places this occupation at the end of the Deadman Wash phase, or near the Transition interval between the Archaic and Late Prehistoric periods. The Deadman Wash phase is characterized generally as representative of a subsistence based on a stabilized balance between hunted and collected foods, with groundstone artifacts well represented diverse faunal assemblages, and a variety of fire and roasting pit types. A wide variety of projectile point styles is represented, with a predominance of medium-sized, triangular, corner-notched dart points. Some evidence of surface structures is documented from components of this age (Armitage et al. 1982). The Transition interval is expected to encompass components exhibiting mixed traits from this phase and the succeeding Late Prehistoric Uinta phase.

The cultural remains recovered from Component 1 at the Buffalo Hump site are few in number and fairly nondescript in nature. One large, oxidized, basin-shaped pit was documented, around which 9 pieces of debitage and 28 fragments of bone were recovered. The small faunal sample is represented by skeletal remains of pronghorn, unspecified artiodactyl, and jackrabbit. The fill of the feature produced 2 charred goosefoot seeds, 12 charred beeweed seeds, and Cheno-am pollen and aggregates. Although this minimal evidence is of little interpretive value, it does suggest a diverse subsistence based on a balanced dependence upon hunted animal resources and gathered plant foods. The

limited faunal assemblage is varied, with both large and small game represented, and the feature appears to have functioned as a hearth or roasting pit. Based on the minimal evidence from Component 1, it compares favorably with the applicable traits defined for the Deadman Wash phase.

The Uinta phase of the Late Prehistoric period is represented by both Components 2 and 3 with averaged radiocarbon ages of 1406 ± 33 years for Component 2 and 1202 ± 35 years for Component 3. The Uinta phase is distinguished by a marked increase in frequencies of radiocarbon dates, and sites with components of this age are most numerous represented of all the other defined phases. Generally, this phase represents a continuation of Archaic adaptations expressed as a basic hunter-gatherer lifestyle with minor changes in the subsistence base and major technological changes represented by the introduction of the bow and arrow and, to a lesser degree, ceramics. Projectile point styles tend to be small, corner-notched or stemmed arrow points with the Rose Spring type well represented. The abundance of groundstone artifacts and charred seed remains from hearth and pit features indicates that plant foods were an important part of the subsistence base. Animal resources continued to be important in the subsistence base, with evidence of a shift toward greater utilization of pronghorn antelope commonly in the context of the communal hunt. Bison procurement also persisted, with singular evidence of a communal bison hunt at the Wardell site (Frison 1973). Zier et al. (1983) also suggest that Fremont influences became apparent during the Uinta phase in the Wyoming Basin.

At the Buffalo Hump site, the cultural remains from Components 2 and 3 show a number of similarities to the general characteristics of the Uinta phase. Projectile points are represented primarily by the Rose Spring type and similar corner-notched varieties but with the unique inclusion in Component 3 of the Ruby Corner-notched type, most commonly documented from sites on the Plains to the east (Irwin and Irwin 1959; Irwin-Williams and Irwin 1966). The subsistence evidence in both components indicates a strong emphasis on procurement and processing of plant seeds, particularly with goosefoot. Animal resources were also exploited, apparently for optimal recovery of nutrients in selected skeletal portions of bison and pronghorn with more complete utilization of the carcasses of smaller animals such as jackrabbit and rodent. There is no evidence of communal hunting; in fact, the relatively small faunal samples suggest that procurement of animal resources was not emphasized during these occupations. The presence of the skeletal remains of canids in both components and bobcat, badger, and bird in Component 2 represents a greater diversity of exploited fauna than is presented in the general description of the Uinta phase. Other differences between the Buffalo Hump data and the general traits of the Uinta phase are represented primarily by additions of specific attributes. Most notably, the presence of pit structures of this age is unique in the Wyoming Basin. Other similar pit structures have been recorded at sites dating from 4000 to 6000 years ago, but the Buffalo Hump pit structures are singular in their more recent age in the Uinta phase. Another additional attribute is the abundance of ornamental or nonutilitarian objects made from stone, bone, shell, and juniper seed. Although such decorative artifacts are not mentioned by Zier et al. (1983) in the Uinta phase, similar specimens have been

recovered from several other sites of the same age in southwestern Wyoming (Bower et al. 1986; Smith 1987c; Schroedl 1985). These objects should be considered a trait of this phase. The absence of ceramics from Components 2 and 3 is another difference from the described Uinta phase, although pottery is relatively rare in sites of this age from the Wyoming Basin, so the Buffalo Hump components are not unusual in lacking this class of artifact.

The Uinta phase components from the Buffalo Hump site correlate favorably with the dates and general trait descriptions proposed by Zier et al. (1983). The primary differences are the additional attributes seen in the Buffalo Hump data. However, Zier et al. (1983) open their discussion of the Uinta phase by stating that their description is admittedly summary in nature because of the abundance of documented components dating to this age. Had they attempted a more detailed description, these additional attributes probably would have been included. The exception is the pit structures, which are the only ones documented from Uinta phase contexts in the area. These pit structures and the nonutilitarian artifacts of stone, bone, shell, and juniper seed might be considered as expressions of Fremont influence, although similar structural remains and artifacts are also documented in components of the same age from the Plains to the east (Wedel 1986:83, 85). The Rose Spring projectile points may also be considered as indicative of Fremont, or at least Great Basin, influence; but without the specifically diagnostic ceramics and other traits, this affiliation cannot be substantiated. The evidence for a strong emphasis on gathering and processing of indigenous, wild plants at Buffalo Hump is a trait that should receive greater attention in addressing the Uinta phase. When Zier et al. proposed their phase descriptions, no single site had produced this amount of evidence for such a heavy reliance on plant foods, whereas far more sites exhibited ample evidence of emphasis on hunting of both large and small game. With recent trends in cultural resource management toward extensive excavation of large areas and improved techniques for recovery of plant remains, more evidence of the importance of plant gathering in Uinta phase economies will probably be recovered. Ultimately, as more data are generated from extensive data recovery programs at sites in the Wyoming Basin, the definition of the Uinta phase probably will be supported and augmented by detailed evidence of its cultural patterns and lifeways.

Regional Model of Subsistence and Settlement

The second major research theme addresses the validity of the model of seasonal subsistence and settlement in the Rocky Mountains proposed by Sanders et al. (1982). Briefly, the model portrays a yearly seasonal round that used mountains in the summer, foothills in the spring and fall, and basins in the winter. The reasoning behind this model appears to be purely practical: mountains would be accessible only in the summer which is the only season when edible resources are available there; basins would offer the harshest environment in the summer and mildest in the winter, although they could be occupied year-round; and foothills would be occupied during the period of transit between the other zones. The variable altitudes and environments of the three zones would also produce variable schedules of plant growth, which influence availability of both edible plants and animals. They go on to state that spring would be expected to be the lean period because resources

stored for the winter usually would have been depleted by spring. Therefore, one would expect "heavy reliance on small mammals, complete utilization of procured animals, and procurement of any edible plants as they become available" (Sanders et al. 1982:232). This model was proposed as a result of an inventory and evaluation of sites in a foothill zone, and data collected from some sites supported the hypothesis of spring occupations.

In order to address this model, there must be some evidence of the season of occupation. Several kinds of evidence may be considered as indicative of seasonality. In faunal remains, proportions of male and female individuals in artiodactyls might suggest the season of procurement because of their herding habits. Also, determinations of the ages of individual animals may indicate the season of procurement in species which have well documented, seasonal reproductive cycles. No such evidence was encountered in the faunal remains from the Buffalo Hump site. Other, less direct indicators of seasonality may be interpreted from the evidence of plant exploitation in the subsistence base. Because the nutritionally valuable parts of plants are produced during specific seasons, the presence of these remains and/or the groundstone implements used to process them may suggest an occupation at the time of their availability. Two types of seasonally indicative plant remains are most commonly recovered from archaeological contexts in this area: pollen and charred seeds. Both types of plant remains were recovered from Components 1, 2, and 3 at the Buffalo Hump site in significant quantities, as were fragments of groundstone implements.

The ample evidence of plant procurement and processing from three components at the Buffalo Hump site suggests that the site was occupied during the spring, summer, or early fall when pollen and seeds are produced and available on the plants. The possibility of stored supplies of seeds that may have been used during winter months poses some question to this seasonal interpretation. Long-term storage of whole seeds is documented in the ethnographic literature (Kelly 1932:98), although commonly the seeds were dried, parched, and ground into flour or meal as part of the collection activity and the meal was then stored for long periods of time. If the bell-shaped pits served as long-term storage facilities for whole seeds or even meal, they probably would have been lined with rocks, grass, brush, or the materials stored in containers to inhibit disturbance by animals. There is no evidence that the pits were lined. If the stored seeds had been in containers, it is unlikely their retrieval would have resulted in the accidental deposition of such large quantities of seeds. In view of these considerations, the abundance of charred seeds and the significant amounts of pollen recovered from the features in Components 1, 2, and 3 are probably indicative of intensive collection and processing activities that occurred during the warmer months. A late summer or early fall occupation is indicated by the fact that the majority of charred seeds are from goosefoot, a plant which produces seeds from August through September. The presence of other seeds from plants which reproduce slightly earlier in the year (mustards and grasses) may indicate that the site's occupants arrived as early as July and remained or returned throughout the summer and into the fall.

If the evidence in the floral remains and groundstone is considered to be indicative of occupations that occurred at times in the summer through fall, the Buffalo Hump site does not fit with the model of

seasonal subsistence and settlement proposed by Sanders et al. (1982). Because the site is located in the Great Divide Basin, evidence of winter occupation would be expected according to the patterns proposed in the model. Apparently, the seasonal rounds of the inhabitants of the Buffalo Hump site put them in the basin during the summer and fall in order to exploit the abundant floral resources available there. If the weather patterns in the past were similar to those at the present time, the Great Divide Basin would not have been a preferred winter habitat because of harsh conditions due to its wide open expanses, lack of shelter, and scarcity of firewood. More desirable wintering grounds are available in the higher, broken terrain around the margins of the basin, where the more rugged topography offers sheltered valleys and canyons, and greater densities of larger firewood are available. Although the model proposed by Sanders et al. (1982) may be reflected in sites from outside the Great Divide Basin, the unique attributes of the basin itself appear to have dictated different patterns of seasonal subsistence and settlement. As more sites from within and around the Great Divide Basin are investigated, it will be necessary to formulate new models of seasonal rounds and subsistence of the prehistoric inhabitants of the region.

Paleoenvironmental Reconstruction

The reconstruction of the paleoenvironmental history at the Buffalo Hump site is derived from three lines of evidence: palynological data, which reflect the biological aspects of the environment; sedimentological data, which represent the physical elements acting upon the environment; and radiocarbon data, which provide the temporal framework for the historical sequence of environmental conditions. Generally, these data are used to develop the historical succession of variable climatic conditions and the paleoenvironments because the combination of external or extrinsic physical conditions that influence the development of organisms (Morris 1981) in the past are interpreted as the outcome of interactions between climate and the biosphere. Ultimately these interpretations help to explain why a particular archaeological site was occupied by man at particular times in the past.

The environmental data from Buffalo Hump indicate that the climate was essentially the same in the past as it is in the present, at least in the past 2000 years. Variation in climatic conditions occurred as minor fluctuations, or pulses, in the degree of temperature and moisture that were prevalent at times. Cooler and/or wetter conditions (mesic) fluctuated with warmer and/or dryer conditions (xeric) in alternating periods of relatively short duration. At the Buffalo Hump site, the geomorphological history indicates that a depression formed by a drainage head sometime after the end of the Pleistocene was filled in by eolian processes to produce a shadow deposit. The lowest strata, which predate the sand deposits containing cultural components, represent the earliest, neoglacial (ca. 3500-5500 years B.P.) or older deposits, when conditions were much wetter than in all succeeding periods up to the present. The extreme mesic conditions at this time are reflected in the presence of pollen from a type of algae that grows in standing water, a situation which may have been common during the development of the ancient drainage head. According to the sediment analysis, the lowest analyzed stratum contains a major disconformity, noted in a number of

sites in the area, which represents a drought that occurred between about 3500 and 2500 years ago.

The upper sand in the homogenous, shadow deposits contains the cultural components. The sediment analysis indicates that minor pulses of increased pluvial, or mesic, conditions occurred during five periods in the last 2000 years: 1900-1800 B.P., 1600-1500 B.P., 1350-1200 B.P., 1100-900 B.P., and around 500 B.P. The intervals between these pluvial periods were marked by a return to more xeric conditions. Generally, the palynological data agree with this sequence. A major difference is the interpretation of a considerably warmer/drier episode at 1480 years ago, based on the decrease in frequencies of pine, sagebrush, and grass pollens in relation to a significant increase in Chenopodium pollen. The contrasting interpretations of the climate from about 1500 years ago may be a product of the fact that this period coincides with the Component 2 occupation. The influence of man upon his environment must not be underestimated, and it is this influence that is probably reflected in the data from both pollen and sediments. In the pollen data, the significant increase in Chenopodium pollen may be attributable to the apparent purpose for occupying the site, i.e., intensive collecting and processing of goosefoot seeds. This emphasized activity may have resulted in increased frequencies of Chenopodium pollen in the background rain during occupation as well as increasing the potential for growth of more dense stands of the pioneer weed in the disturbed soils on the site after occupation. Because of the enhanced environment for goosefoot plants, their unnaturally dense growth may have caused a slight lag in the natural succession of revegetation on the site after its abandonment. This same factor may also have influenced the nature and attributes of the sediments. Surface turbation by humans, increased carbon content, and subsequent plant florescence may have produced traits in the sediments that are normally interpreted as reflecting wetter, cooler conditions. The higher carbon content and presumably more dense vegetation may have increased the ability of the cultural deposits to hold water. Therefore, the results of the analysis would be interpreted as reflecting wetter conditions than actually may have been the case in the corresponding stratum from off the site. Generally, in both analyses of pollen and sediments, the degree of human influence on the sampled deposits may have skewed the two sets of data to produce contradictory interpretations.

A determination of which interpretation most accurately reflects the climate from 1500 years ago is difficult to assess. Because the sediment analysis did not clearly present the data used to support the interpretation of a mesic episode, this argument cannot be evaluated. It is quite possible that the degree of human influence on sediments deposited from fairly short-term occupations would be minor and that the overall characteristics of the sediments actually reflect gross trends in climatic intervals of much longer duration. Although the pollen data also represent overall, regional trends, the problem of on-site sampling may have a greater effect on the results because of the extent to which pollen counts reflect human influence, particularly if there was intentional manipulation of the on-site environment to encourage the growth of favored plants such as goosefoot. To solve the question of the nature of the climate 1500 years ago, it will be necessary to sample pollen and sediments from noncultural deposits, which may then be correlated temporally with the sequences from the on-site contexts.

Given the more complete data base, interpretations of both the regional climate and the degree of influence on the environment by to human manipulation may be supported and refined.

Generally, the paleoenvironmental interpretations based on analyses of sediments and pollen indicate that the site was occupied during periodical fluctuations in cooler and/or wetter climatic conditions. The first three pulses of increased pluvial conditions defined by the sediment analysis coincide with the ages of Components 1, 2, and 3. Although it was not dated, Component 4 may have occurred during one of the last two episodes of cooler and/or wetter conditions. The contrasting interpretation from pollen analysis of the warmer/dryer episode at 1500 years ago during the Component 2 occupation may be exaggerated due to the degree of human influence. In the broadest sense, the Buffalo Hump site appears to have been occupied during mesic periods when increased moisture would have resulted in increased quantities and varieties of plants and increased numbers and varieties of animals that depend on them for food. These conditions increased the amount and variation of resources available for exploitation by the site's inhabitants of the site.

SUMMARY

The Buffalo Hump site is a camp or residential locus in the Great Divide Basin that was occupied at least four times in the past 2000 years. The results of these investigations indicate that the collection and processing of floral resources was the major focus of subsistence during three of the occupations and that semisubterranean structures, or houses, were constructed for residence and/or as specialized shelters for processing seeds. Prior to the construction of the Exxon Bairoil/Dakota Carbon Dioxide Pipeline, Section One, excavation of 318 m² yielded evidence of four cultural components, three of which produced datable remains from features and associated cultural material. The fourth, most recent, component, situated just below the present ground surface, was too disturbed and ephemeral to yield interpretable cultural remains. This component is represented only by a few debitage flakes and bone fragments.

Component 1 is the oldest occupation, with an averaged radiocarbon age of 1800 ± 79 years, which places it in the Deadman Wash phase as defined by Zier et al. (1983). The relatively minor amounts of cultural remains suggest a fairly short-term occupation that involved subsistence activities related to processing of both plant and animal resources. One large, oxidized, basin-shaped pit was documented, around which was scattered cultural debris in the form of fired rock, 9 debitage flakes, and 28 fragments of bone from pronghorn, artiodactyl, and jackrabbit. Fourteen charred seeds from beeweed and goosefoot plants were recovered from the fill of the pit, and Chenopodium pollen was documented from within and around the pit. Although no groundstone was found, the presence of plant remains suggests that gathering and processing of floral resources took place during this occupation, which probably occurred at some time in the summer or fall months when the plants produce their pollen and seeds. At the same time, animal resources appear to have been exploited and processed for their optimal nutritional value by rendering the bones for production of grease and juice.

The occupation represented by Component 2 took place about 400 years later during the Uinta Phase of the Late Prehistoric period with an averaged radiocarbon age of 1406 ± 33 years. Features and cultural remains were concentrated into three activity areas, two of which contained pit structures, or semisubterranean shelters, the third being an outside activity area. The shelters appear to have been constructed of sagebrush or other local bushes and built over shallow, excavated depressions for the primary purpose of creating windbreaks in which to process and stockpile goosefoot seeds. Outdoor activities took place around the shelters. These included processing of animal resources for food, fabrication of utilitarian and ornamental objects, lithic reduction on a small scale, and seed processing activities primarily of plants such as Indian ricegrass, beeweed, mustard, and sunflower as well as goosefoot. In addition to intensive seed gathering and processing, the subsistence base included exploitation of animal resources, the processing of which appears to have taken place outside the shelters. Bison and pronghorn were exploited primarily for optimal recovery of the nutritional value present in their limb bones (i.e., extraction of marrow, grease, and juice), and smaller animals, such as jackrabbits, rodents, and birds, were procured as whole carcasses for consumption. Carnivores, such as coyote, bobcat, and badger, may have been hunted intentionally for their furs or killed during fortuitous encounters. The abundant evidence of seed processing suggests that this occupation took place during the late summer or early fall as part of the seasonal round of a small group composed of one or two nuclear families who came to the basin to engage in intensive seed gathering and processing activities to amass stored supplies of nutrients on which to subsist during the unproductive winter months.

Component 3 represents an occupation which occurred about 200 years later but still within the Uinta phase of the Late Prehistoric period with a mean radiocarbon age of 1202 ± 35 years. The types, quantities, and distribution of cultural remains are so similar to those from Component 2 that an affinitive cultural group is indicated. Three activity areas are represented in the excavation block by concentrations of features and cultural remains. One activity area contains a pit structure with dimensions and characteristics equivalent to those in the structures from Component 2. Intensive collection and processing of goosefoot seeds appears to have taken place within this shelter, and other kinds of activities seem to have been the focus of surrounding outdoor work areas. Processing of animal resources took place around exterior hearths and boiling pits. This included the rendering of bones of bison, canids, jackrabbits, and rodents to recover the maximum amount of nutrients, particularly concentrated in the long bones of the larger animals. The long bones of smaller animals and mussel shell were used to fashion nonutilitarian, decorative objects, an activity that was primarily centered around one outdoor activity area. Also in this same area, lithic reduction was a focus of activity. Locally available raw materials were used to manufacture formal and expedient tools with which to carry out the other tasks. As in Component 2, a summer through fall occupation is indicated by the considerable evidence of seed gathering and processing activities. The evidence from Component 3 indicates that a cultural group similar to the one described in Component 2 occupied the basin for the primary purpose of gathering plant food resources in anticipation of subsisting through the lean, winter season.

The data recovery program at the Buffalo Hump site has produced new, detailed information which contributes significantly to our knowledge of the lifeways of the prehistoric inhabitants of the Great Divide Basin during the past 2000 years. It is hoped that many aspects of this investigation and interpretation might serve as models for future research and definition of cultural phenomena, or at least to provoke controversy which might lead to the resolution of some of the more puzzling questions about the past. At the very least, this investigation should demonstrate the value of extensive, large scale excavations from which more complete, detailed data recovery can be directed toward a fuller understanding of past behaviors.

CHAPTER SIX · MANAGEMENT SUMMARY

PROJECT SUMMARY

One of the significant archaeological sites to be directly affected by the construction of the Bairoil/Dakota CO₂ Pipeline, Section One, by Exxon Pipeline Company was the Buffalo Hump site, 48SW5057, located in the western portion of the Great Divide Basin in Sweetwater County, Wyoming. In order to mitigate adverse impacts to the site, as required by federal regulations concerning cultural resources, a data recovery program was conducted. This was composed of two major phases divided into five stages of investigation. The first phase concerned exploratory reconnaissance to determine the location and nature of subsurface cultural deposits and was divided into three stages based on the techniques used to implement this testing phase. The second phase consisted of intensive data recovery of the cultural resources documented in the pipeline right-of-way by means of excavating large block areas. This phase was composed of two stages due to the fact that excavations were conducted at two intervals in the fall of 1985 and spring of 1986 interrupted by inclement weather conditions during the winter. A total of 318 m², or 265.91 m³, was excavated entirely by hand during both phases of investigation.

The data recovery program at the Buffalo Hump site produced evidence of four cultural components representing occupations that took place during the past 2000 years in the Late Archaic and Late Prehistoric periods. In three of the components, 35 cultural features were documented, most of which were hearths, roasting/storage pits, and middens. Three housepits, or pit structures, were recorded in two components of Late Prehistoric age. The nature and distribution of the cultural remains recovered from within and around these features indicate that the site was occupied during the late summer or fall by small groups, composed of one or two nuclear families, who stayed for a period of days or weeks for the primary purpose of collecting, processing, and stockpiling seed food resources from local, wild plants. Animal resources from large and small game were also processed and consumed, probably in the context of daily meals. Manufacture of flaked stone tools made from local raw materials and used in daily subsistence tasks took place on a small scale, and fabrication of nonutilitarian, decorative objects of bone and shell was important. The houses were probably constructed of sagebrush fashioned into a low dome placed over a shallow circular depression. These were used primarily as shelters in which seed processing and stockpiling took place. The evidence suggests that once the seed gathering was completed, the small bands moved on to another location in their yearly seasonal round.

These kinds of interpretations about human behavior in the past are possible only when sufficient amounts of the appropriate types of data are recovered. The research design for the Buffalo Hump site emphasized the need for excavating large block areas to expose and document in detail the surface of each cultural component, employing the greatest degree of control and technical expertise that current archaeological methods and budgetary constraints will allow. The need for fine-tuned, comprehensive sampling of cultural features and occupation surfaces for pollen, plant macrofossils, and other kinds of minute remains of cultural activity is essential. Likewise, sampling of environmentally relevant data, such as pollen and sediments, is necessary in order to interpret the natural conditions of the surroundings in which the

people lived and interacted. Comparisons of the archaeological data with information derived from historic and modern ethnographic studies of similar cultural groups contribute a degree of validity to interpretations of prehistory. Only when given such a detailed, inclusive data base is it possible to formulate and substantiate interpretations of past cultures and the ways the people organized their lives and adapted to their environment.

RECOMMENDATIONS

The Buffalo Hump site has been evaluated as eligible for nomination to the National Register of Historic Places because of the excellent integrity of its subsurface cultural remains, which contribute significantly to new, detailed interpretations of the cultural adaptations and lifeways of the prehistoric inhabitants of Wyoming during the last 2000 years. The results of this data recovery program at site 48SW5057 are sufficiently conclusive to be considered as mitigating adverse impacts to the site due to construction of Exxon's Bairoil/Dakota CO₂ Pipeline, Section One, and cultural resource clearance has been² approved for this action.

If in the future further surface disturbing actions are proposed within the established pipeline corridor through 48SW5057, it is recommended that a cultural resource data recovery program be implemented prior to initiation of surface disturbance. This data recovery program should start with exploratory reconnaissance for subsurface cultural deposits within the specific area to be impacted by the proposed actions. If significant cultural resources are documented as a result of subsurface exploration, it is recommended that large scale excavations then be conducted to recover the archaeological data within the area to be disturbed prior to initiation of the proposed action.

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APPENDICES

APPENDIX A

Feature Analysis

Lynn L. Harrell

Thirty-five features were excavated during the 1985-1986 investigations at the Buffalo Hump site. The morphological classification defined five types: 3 pit structures, 7 bell-shaped pits, 16 basin-shaped pits, 5 irregular shallow basins, and 4 midden/rock concentrations. Features were recorded from three of the cultural components: 1 from Component 1, 20 from Component 2, and 14 from Component 3. Each of the feature types is represented in Component 2, and four types are associated with Component 3.

After a brief description of the methods of analysis, each of the five feature types is described. The classification and descriptions of types focus on morphology, with component associations, relationships with other features, and content of the fill. Interpretations of the functions of each feature type are presented as conclusions.

METHODS

Feature types were defined primarily on the basis of morphological attributes such as dimension, surface area, volume, and shape. Visual inspection of the constellation of morphological attributes from each feature resulted in the classification of the five types. Other traits were distinguished in order to discriminate among the more numerous members of some types. The bell-shaped and basin-shaped pits were examined for presence or absence of oxidation, creating subsets in each of these two types. In addition, size grades of these two types and the irregular, shallow basins were established by plotting surface area and volume (Figure 1) to differentiate small, medium, and large sizes. These two dimensional variables were calculated by the formulas:

$$\text{Surface area} = \frac{(\text{length} + \text{width})^2}{4}$$

and

$$\text{Volume} = 2/3 \pi (\text{depth}) (\text{length}/2) (\text{width}/2)$$

The equation for volume produces cm^3 , which is then converted to liters by multiplying cm^3 by 1000. These equations represent perfect geometric shapes. Because features have slightly irregular shapes, the dimensions derived through these equations are estimations of surface area and volume. Table 1 presents the groups of feature types and summarizes the quantitative data recorded from all features excavated in 1985 and 1986. The original feature numbers designated in the field are used to maintain consistency in the data rather than reassigning numbers according to the classified types. Feature numbers missing from the sequence are those that were assigned originally to manifestations which ultimately lacked definition sufficient for feature designations.

In addition to the features recorded from excavations, ten others were encountered during the blading and trenching of the site for pipeline construction (Burchett 1987). Because of the different context of investigation, most of these ten features were documented in general descriptive terms, with locations and surface dimensions as the only

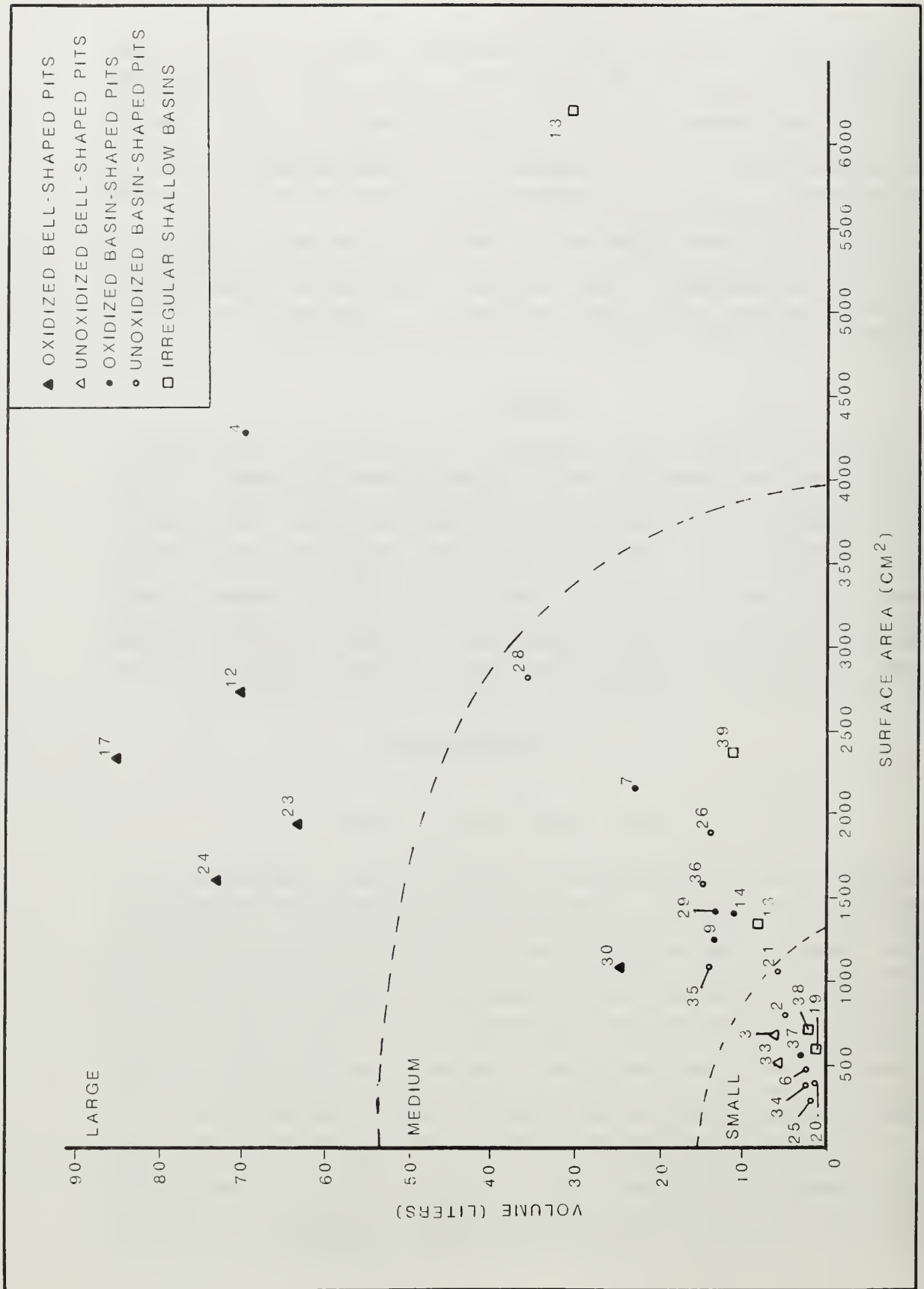


Figure 1. Graph showing the relationship of volume and surface area for three feature types, from which size grades were derived for the Buffalo Hump site.

Table 1. Quantitative data for features documented at the Buffalo Hump site.

Feature Type Subtype Size grade	Feature Number	Length (cm)	Width (cm)	Depth (cm)	Surface Area (cm ²)	Volume (liters)	Radiocarbon Estimation	Cultural Component
Pit structure	8	210	200	43	32,990	943.6	-	3
	16	228	215	63	38,514	1613.6	-	2
	27	196	156	47	24,316	750.9	-	2
	48*	220	220(?)	35	37,994(?)	885.1(?)	-	3
Bell-shaped pit Oxidized Large	12	70	50	38	2826	69.5	-	3
	17	61	49	54	2375	84.3	1290 ± 60 years B.P.	3
	23	50	50	48	1963	62.7	-	2
	24	44	51	62	1771	72.7	1480 ± 60 years B.P.	2
Medium	30	46	30	34	1134	24.5	1250 ± 60 years B.P.	3
	41*	50	50	50	1963	39.2	-	-
Unoxidized Small	3	33	27	13	707	6.0	-	2
	33	26	25	17	511	5.8	-	2
	49*	24	24(?)	24	452(?)	7.2(?)	1300 ± 100 years B.P.	3
Basin-shaped pit Oxidized Large	4	74	74	24	4299	68.7	1870 ± 80 years B.P.	1
	7	55	50	16	2164	23.0	-	2
Medium	9	43	37	16	1256	13.3	-	3
	14	45	40	12	1418	11.3	-	2
	29	50	36	18	1452	13.5	-	3
	37	30	24	8	572	3.0	-	2
Small	44*	45	45	7	1590	7.4	-	-

Table 1. Concluded.

Feature Type Subtype Size grade	Feature Number	Length (cm)	Width (cm)	Depth (cm)	Surface Area (cm ²)	Volume (liters)	Radiocarbon Estimation	Cultural Component
Basin-shaped pit (continued) Unoxidized	42*	90	80	20(?)	5672	75.2(?)	-	-
	26	55	44	11	1924	13.9	-	2
	28	62	58	19	2826	35.7	-	3
	35	40	35	19	1104	13.9	-	3
	36	47	43	14	1590	14.8	-	2
	46*(?)	60	40	-	1963	-	-	-
	47*	75	60	10	3577	23.5(?)	-	-
	2	34	30	9	804	4.8	-	3
	6	30	20	8	491	2.5	-	3
	20	29	17	6	415	1.5	-	2
Small	21	40	34	8	1075	5.7	-	2
	25	20	18	9	283	1.7	-	2
	34	23	21	10	380	2.5	-	2
	40*(?)	30	30	-	707	-	-	3(?)
	45*(?)	20	20	-	314	-	-	-
	13	112	66	8	6218	30.9	-	3
	18	43	40	9	1352	8.1	-	3
	39	63	48	7	2418	11.1	-	2
	19	34	22	3	615	1.2	-	3
	38	32	27	5	683	2.3	-	2
Irregular, shallow basin	1	77	60	6	3683	14.5	-	2
	11	114	82	6	7539	29.3	-	2
	15	145	85	3	10,382	19.3	-	2
	22	260	220	12	45,216	358.6	-	2
	43*(?)	250	200	10	39,741	261.3	-	-
	13	112	66	8	6218	30.9	-	3
	18	43	40	9	1352	8.1	-	3
	39	63	48	7	2418	11.1	-	2
	19	34	22	3	615	1.2	-	3
	38	32	27	5	683	2.3	-	2
Midden/rock concentration	1	77	60	6	3683	14.5	-	2
	11	114	82	6	7539	29.3	-	2
	15	145	85	3	10,382	19.3	-	2
	22	260	220	12	45,216	358.6	-	2
	43*(?)	250	200	10	39,741	261.3	-	-

* Features recorded from construction monitor. Question marks (?) are inserted following questionable designations.

data collected. In most cases, accurate associations with cultural components could not be made. These ten features appear in Table 1 under the types to which they possibly may be assigned based on the limited evidence recovered. In the following discussion of feature types, reference is made to these features, qualifying more detail of their context in the field.

In Figure 2, the locations of all features recorded from excavations are depicted. Figure 3 shows the locations of the ten features documented during monitors of the blading and trenching of the site by Exxon (Burchett 1987) and incorporates the features recorded by Powers Elevation Company (PEC) as a result of the construction of Frontier pipeline (Brechtel et al. 1984). In this discussion of the features from the Buffalo Hump site, features from the previous investigation are addressed summarily whenever appropriate to supplement the data base, increasing the interpretive value of defined components and their activity areas.

FEATURE TYPE DESCRIPTIONS

Each of the feature types is described in terms of the attributes which can be applied generally to all members of that type. Each type is depicted by a drawing of the most typically representative feature. Following the general type description, each of the features is discussed with attention to individual differences, component associations, and relationships to other features.

Pit Structures

Pit structures are large, circular, shallow basins which average about 2 m in diameter and 50 cm in depth (Figure 4). When excavated, they were defined as having interior fill that was noticeably less compact and contained more charcoal and gravels than the surrounding matrix. The bottom 10 cm of fill was dark gray to black, and the upper portion was light gray and mottled with charcoal. The top outlines of the charcoal-stained fill were overlain with roughly circular alignments of rock, which generally conformed with the perimeter of the soil change defined by feature fill. In profile these pit features are saucer-shaped, with gradually sloping sides and rounded floors (Figure 4). These pit structures have variable numbers of interior pit and basin features, one of which is commonly a large, oxidized, bell-shaped pit located on an edge of the structure. Characteristically, few artifacts and cultural debris were recovered from within the structures, and these were usually minor amounts of lithic debitage, animal bone, and small fragments of groundstone and/or thermally altered sandstone. Large amounts of charred seeds, primarily goosefoot, were recovered from the floors of the pit structures and from within the fill of their interior features.

Three pit structures were documented from excavations: Feature 8 from Component 3 and Features 16 and 27 from Component 2. Feature 8 was encountered first in the Frontier pipeline trench but was not recognized as a pit structure by PEC. Apparently their Feature 5 was excavated as a 1 x 1 m unit taken out of the center of the northern one-half of this pit structure (Feature 8). As a result, parts of the northern portion

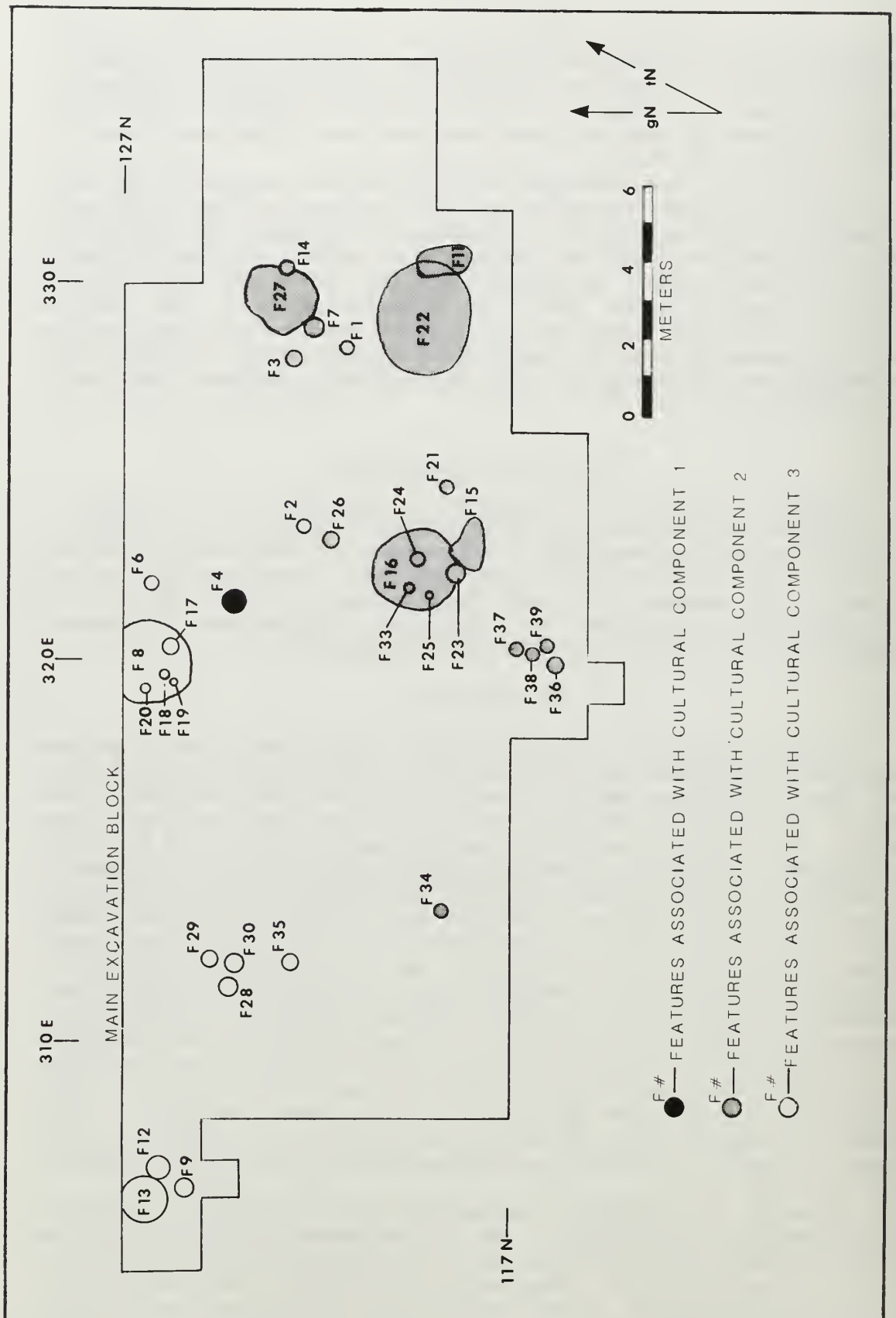


Figure 2. Map of excavation block showing the locations of all features documented from the 1985 and 1986 investigations at the Buffalo Hump site.

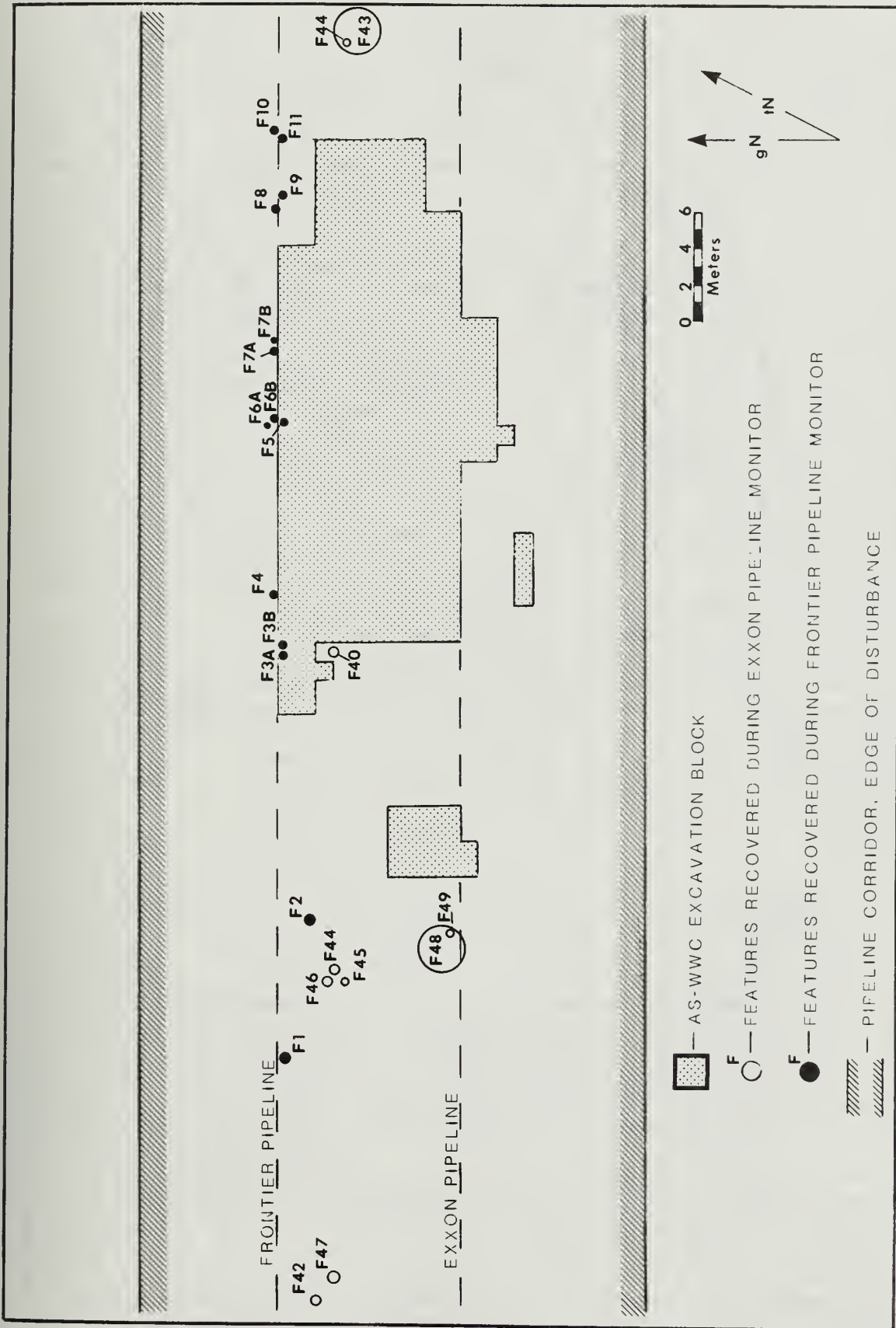


Figure 3. Map showing the locations of features recorded by Powers Elevation Company during monitoring of the Frontier pipeline and the features recorded from monitoring construction of Exxon's Bairoi/Dakota Carbon Dioxide pipeline at the Buffalo Hump site.

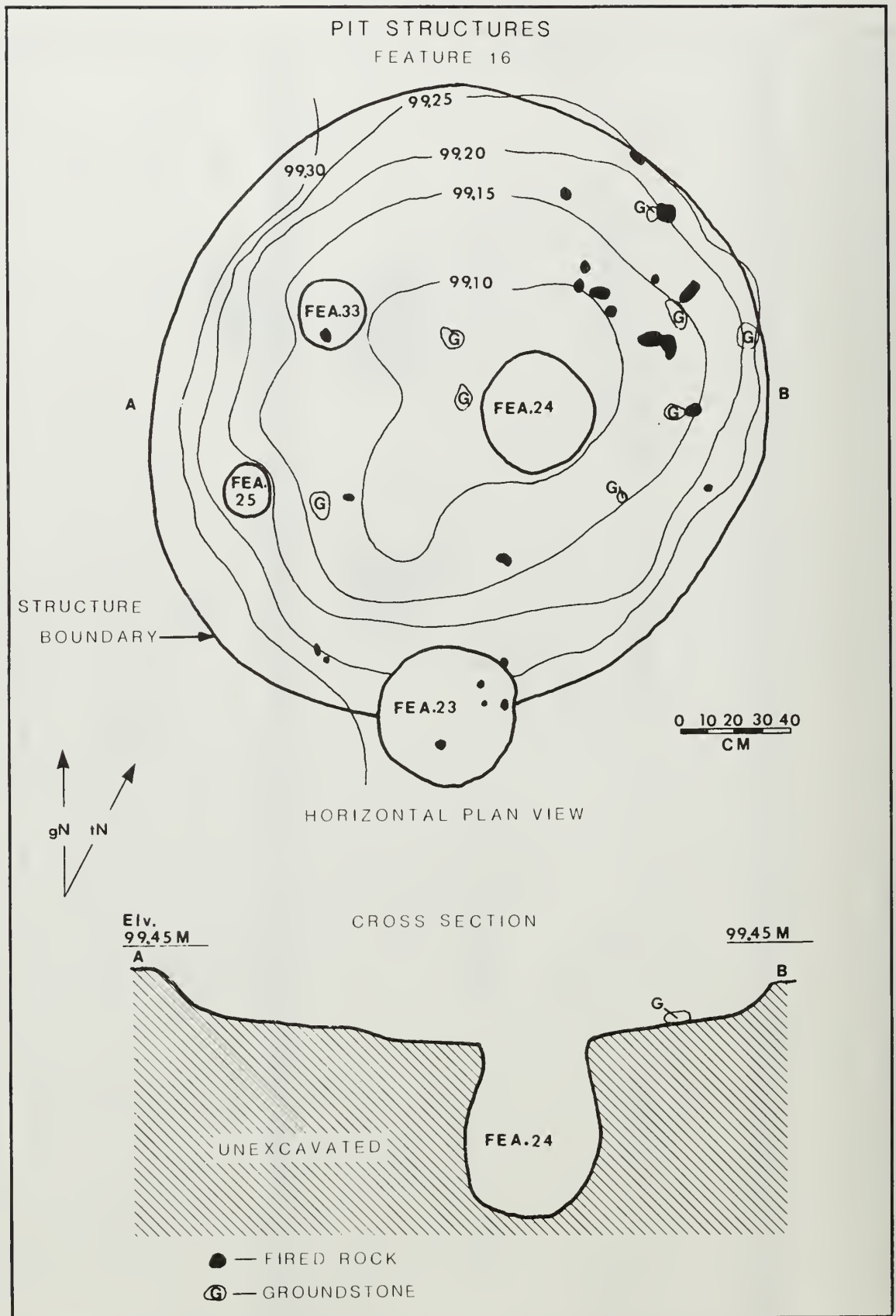


Figure 4. Illustration of a typical pit structure from the Buffalo Hump site.

of Feature 8 were removed previously by investigations associated with Frontier pipeline. Within the remainder of Feature 8, four interior features were documented: a large, oxidized, bell-shaped pit (Feature 17) on the southeastern edge and small, basin-shaped and irregular pits (Features 18, 19, and 20) from near the center. In addition, the PEC unit revealed five small, shallow features which, based on their descriptions, may be irregularities in the floor of the pit structure. A light scatter of cultural debris was recorded to the southeast of Feature 8, which may represent a midden dump. However, the lack of controlled sampling to the north of Feature 8 makes it difficult to assess whether this midden material was concentrated in that area alone.

Feature 16 (Figure 4) is the most completely documented structure, having been recognized in its entirety at its uppermost outline and then excavated by removing quarters. It contained four interior features: two large, oxidized, bell-shaped pits (Features 23 and 24) from the southern edge and center, a small, unoxidized, bell-shaped pit (Feature 33), and a small, unoxidized, basin-shaped pit (Feature 25) from the western part of the floor. An exterior midden/rock concentration (Feature 15) was located adjacent to the south-southeastern edge of the pit structure, and various other types of features were distributed around and within 4 m of its center (see Figure 2). In addition to a few pieces of lithic debitage and fired rock, eight fragments of grinding slab were recovered from the floor of Feature 16 and an equal number from outside and near its periphery.

Feature 27 had its eastern margin excavated before it was recognized as a pit structure. Although no interior, floor features were encountered after its identification and excavation, a medium-sized, oxidized, basin-shaped pit (Feature 14) had been documented from the area of the eastern wall of the pit structure. Another medium-sized, oxidized, basin-shaped pit (Feature 7) was recorded from outside and near the southwestern edge of Feature 27. A small, unoxidized, bell-shaped pit (Feature 3) and a small, midden/rock concentration (Feature 1) were located within 2 m of the southwest edge of this pit structure. Small amounts of fired rock, lithic debitage, and bone were recovered from within Feature 27.

A fourth pit structure (Feature 48) was exposed in the north wall of the Exxon pipeline trench about 30 m west of Feature 16 (Figure 2). Other than documenting the exposed profile of this structure and obtaining a radiocarbon sample, no additional work was conducted (Burchett 1987). Because no trace of the structure was exposed in the south wall of the trench, Feature 48 appears to have been bisected by the trench, the northern half remaining intact. This pit structure is similar to the others in dimensions, shape, and stratigraphy of the fill, and it has the typical bell-shaped pit (Feature 49) located on its eastern edge. Charcoal from Feature 49 produced a radiocarbon estimation of 1300 ± 100 years (Beta-17206), which associates this pit structure with Component 3.

A fifth possible pit structure may be represented by Features 43 and 44 (see Figure 3), which were exposed by the bulldozers during blading of the site for pipeline construction (Burchett 1987). Feature 43 appeared as an oval, black, charcoal stain after the initial sweep of the bulldozers. cursory troweling to investigate depth and shape revealed a distinct, circular, shallow basin (Feature 44) within and on the northwestern margin of Feature 43, which itself appeared to be 8-10

cm deep. Based on the size, shape, and depth of Feature 43 and the location of Feature 44 within the larger stain, Feature 43 may represent the bottom remains of a pit structure. However, lacking other data from the upper portion removed by bulldozers, this interpretation is tenuous. On the basis of such meager evidence, it is equally valid to interpret these remains as a midden concentration (Feature 43) around and to the leeward of a hearth pit (Feature 44). These features cannot be associated with a cultural component.

Bell-shaped Pits

Seven features represent bell-shaped pits, which is characterized generally by pits that are circular in outline and have sides that are vertical to slightly belled with flat to rounded bottoms. In addition to these seven features recorded from excavations, two features from the monitor of blading and trenching may also be representative of this type. Three subtypes are defined on the basis of size and presence or absence of oxidation.

Large, Oxidized, Bell-shaped Pits

Large, oxidized, bell-shaped pits had depths approximately equal to their top diameters so that they appeared in profile as deep pits with constricted necks (Figure 5). Generally the greatest diameter was at or below the midpoint of the profile. The sides were oxidized to a reddish orange color with oxidation averaging about 1 cm in thickness and located continuously around the sides from the tops to near the bottoms, which were free of oxidation. The fills of these features were stratified with dense charcoal concentrations in the bottom portion overlain with a layer of fired rock near the midpoint. The upper portions of their fills contained slightly less charcoal directly above the rocks and became lighter and mottled toward the tops. Feature 23 was the exception to this pattern because it contained a very minor amount of rocks, and oxidation was slight and discontinuous around the sides.

Four features were classified as this subtype. In Component 2, both bell-shaped pits were located in a pit structure (Feature 16): Feature 23 on the southern edge of the pit structure and Feature 24 near the center of the floor. Thousands of charred goosefoot seeds were recovered from the fill of Feature 24. A minor amount of charred plant seeds was recovered from Feature 23. In Component 3, one of the bell-shaped pits (Feature 17) was located in the southern portion of the pit structure (Feature 8), and several hundred charred seeds were recovered from this pit.

The other pit (Feature 12) was located in a cluster of features not associated with a pit structure. Feature 12 was encountered originally by PEC (Brechtel et al. 1984:138-140), who recorded it as Feature 3B (see Figure 3) and excavated its northern one-third. They also documented two shallow areas of charcoal-stained sand directly to the north of Feature 12. The 1985 AS-WWC excavations recorded two features adjacent to Feature 12, and another nearby feature was exposed by blading. A medium-sized, oxidized, basin-shaped pit (Feature 9) and a large, irregular, shallow depression (Feature 13) were located to the southwest and west of Feature 12, and a small, circular stain (Feature 40) was exposed 2 m south of Feature 12.

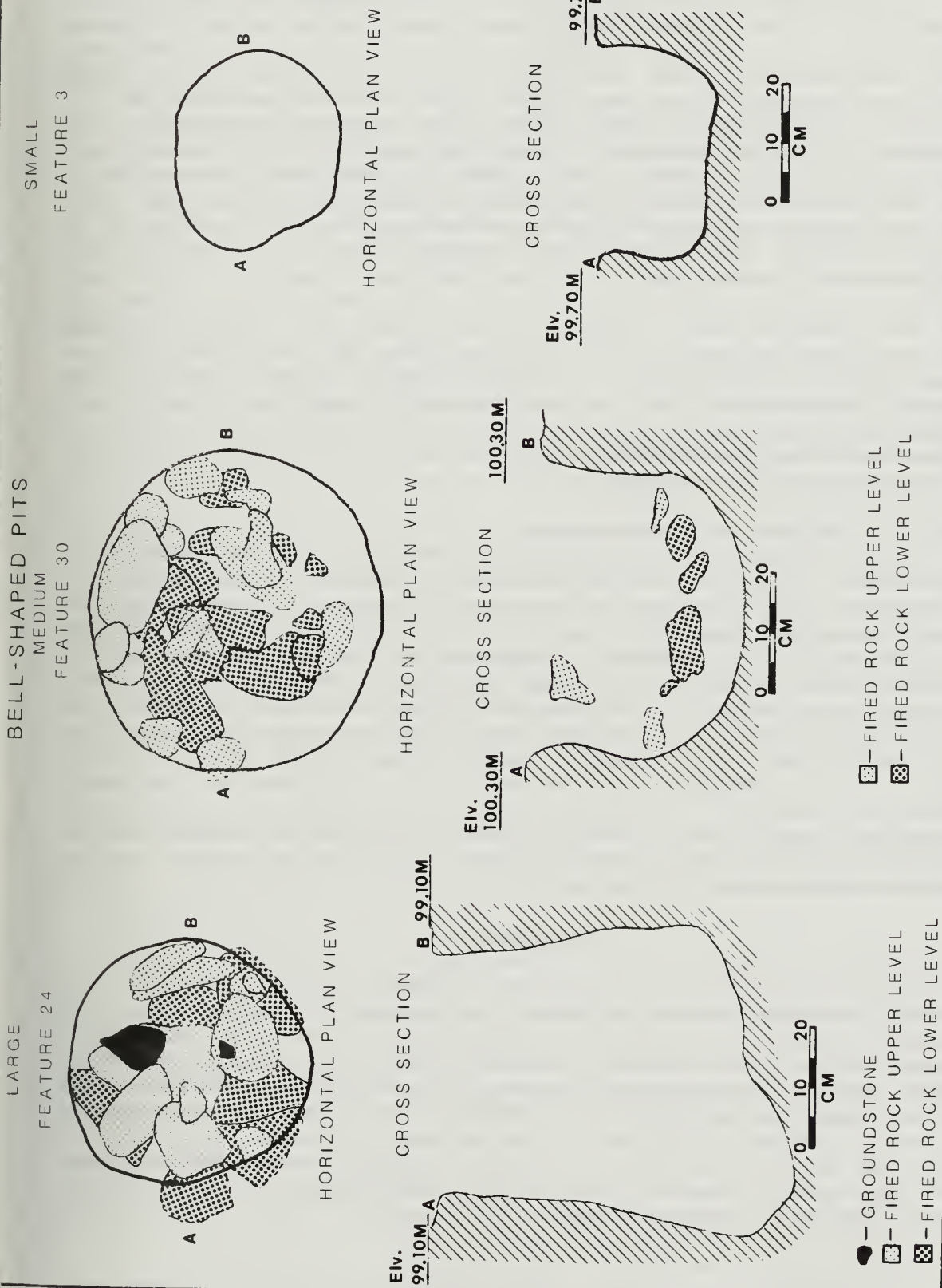


Figure 5. Illustrations of typical bell-shaped pits from the Buffalo Hump site.

Medium, Oxidized, Bell-shaped Pit

One feature (Feature 30) from the excavations and one feature (Feature 41) from the blade monitor were classified as medium, oxidized, bell-shaped pits. Their intermediate size is a product of the fact that they were shallower than the large pits, their average volume being about one-third of the large pits. They were roughly circular in outline; had slightly belled sides with continuous oxidation; and rounded, unoxidized bottoms. A layer of fired rock was located just below the midpoint of Feature 30 (Figure 5). The fill below the rocks was stained black and had large pieces of charcoal, whereas the upper fill was lighter and mottled. This feature was located in a cluster of three features, and a fourth was located 2 m to the south. Two medium-sized, basin-shaped pits, one oxidized (Feature 29) and one unoxidized (Feature 28), were located to the north and west of Feature 30; and a medium-sized, unoxidized, basin-shaped pit (Feature 35) was documented to the south of this group. All of these features were associated with Component 3. Feature 43 was excavated in its west one-half only enough to see the vertical, oxidized sides, flat, unoxidized bottom, and absence of rock. This pit was also one of a cluster of three features (with Features 45 and 46), none of which can be associated with a component.

Small, Unoxidized, Bell-shaped Pits

Two features (Feature 3 and 33) of the subtype small, unoxidized, bell-shaped pits were documented from Component 2, and both were associated with pit structures. A third (Feature 49) was exposed by the trench as an edge feature in a pit structure (Feature 48) from Component 3. However, its inclusion in this subtype is based solely on its exposed shape and size, which may be larger. These small pits were miniature expressions of the larger subtypes but lacked oxidation and rocks (Figure 5). Their average volume was about one-quarter that of the medium-sized pits. Feature 3 was located outside and 1 m to the west of a pit structure (Feature 27), with a medium-sized, oxidized, basin pit (Feature 7) to the southeast and a midden/rock concentration (Feature 1) to the south. Feature 33 was located in the western portion of the floor of a pit structure (Feature 16). Several hundred charred seeds were recovered from Feature 33.

Basin-shaped Pits

Sixteen features are classified as this type. These features are roughly circular in top outline, with gradually sloping sides and rounded bottoms, their greatest diameters being at the top. Generally, these features have diameters that are about three times greater than their depths. Some of these features contained minor amounts of rock, an attribute that appeared to be random and not indicative of subtypes. A more significant attribute is the presence or absence of oxidation, which was used to distinguish two broad subtypes. Within each of these subtypes, size grades were established (see Figure 1). Each of the sized subtypes is described below.

Oxidized, Basin-shaped Pits

The oxidized, basin-shaped pits had variable amounts of oxidation visible on their sides, primarily as discontinuous patches on the upper

sides or rims. Three size grades were distinguished in the six features from this subtype (Figure 6). One other feature was recorded from blade monitor.

Large

One feature (Feature 4) falls into the large subtype and is the only feature documented from Component 1. Oxidation was discontinuously present on the sides, bottom, and parts of the interior fill (Figure 6). The fill was differentiated with very black, charcoal-laden soil on the bottom overlain by dark, charcoal-flecked soil and light, tan sand on the very top. This stratigraphic sequence is typical of natural back-filling. No cultural material was recovered from within and around this pit.

Medium

Four features (Features 7, 9, 14, and 29) were classified as medium. Their average volume was almost one-fifth that of the large pit. Two of these features (Feature 7 and 14) were from Component 2 and both were associated with a pit structure (Feature 27) as external features. Feature 7 was located directly adjacent to the southwest edge of the pit structure, and Feature 14 was documented at the interior, eastern edge of the pit structure. Also associated with Feature 7 was a small, unoxidized, bell-shaped pit (Feature 3) to the northwest and a small, midden/rock concentration (Feature 1) to the southwest.

In Component 3, the two basin-shaped pits (Feature 9 and 29) were each associated with clusters of features. Feature 9 (Figure 6) was located immediately southwest of a large, oxidized, bell-shaped pit (Feature 12) and south of an irregular, shallow basin (Feature 13). Feature 29 was situated to the north of a medium, oxidized, bell-shaped pit (Feature 30) and to the northeast of a medium, unoxidized, basin-shaped pit (Feature 28). Both clusters of features represent activity areas external to pit structures.

Small

One feature (Feature 37) of the small subtype was documented during the excavations, and another (Feature 44) was recorded during the blade monitor. The volume of Feature 37 is about one-fifth the average volume of the medium-sized subtype.

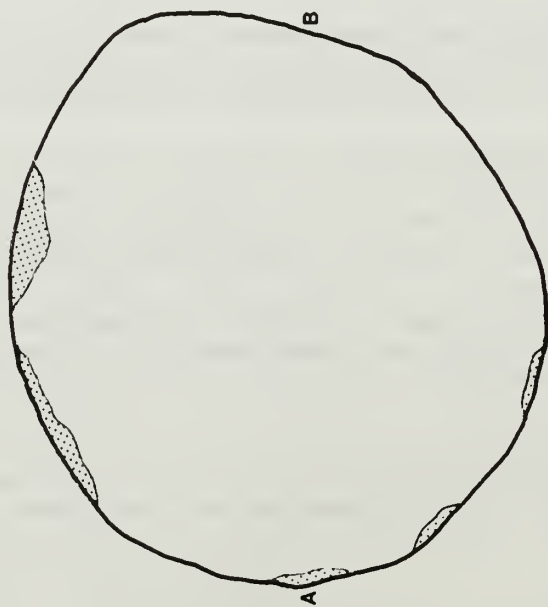
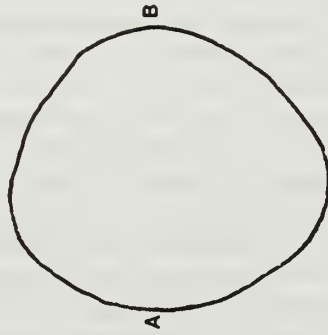
Feature 37 was one of a cluster of four features (Feature 36, 37, 38, and 39) located about 2 m southwest of a pit structure (Feature 16) from Component 2. This feature is unique because oxidation was visible in the fill and not on its edges. It was the northernmost feature of the cluster.

Feature 44 from the blade monitor was located on the northwest edge of a midden feature (Feature 43), which may represent the bottom of a pit structure. Neither feature could be associated with a component.

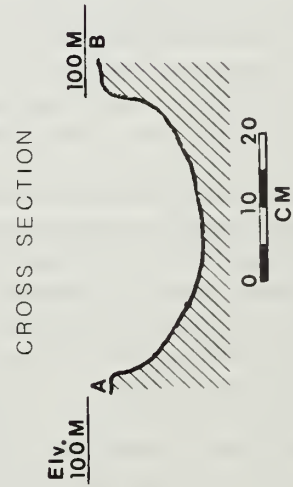
Unoxidized, Basin-shaped Pits

The unoxidized, basin-shaped pits contain the largest number of features. Ten were documented from the excavations, and two were recorded during blade monitoring. Three size grades are represented.

BASIN-SHAPED PITS

LARGE
FEATURE 4MEDIUM
FEATURE 9

HORIZONTAL PLAN VIEW

SMALL
FEATURE 34

HORIZONTAL PLAN VIEW

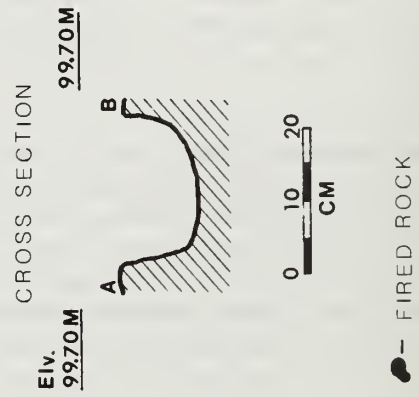


Figure 6. Illustrations of typical basin-shaped pits from the Buffalo Hump site.

Large

One large feature (Feature 42) was recorded during blade monitoring. Its inclusion here may be unjustified because the depth was determined by cursory trowel probing after its top had been removed by bulldozers. Another feature (Feature 47), which may have been a medium-sized pit of the same subtype, was situated 1 m northwest of Feature 42. Both features were located more than 30 m west of the excavation block and cannot be associated with a component.

Medium

Four medium features (Features 26, 28, 35, and 36) were documented from the excavations. Two others from the blade monitor (Features 46 and 47) may also be representative of this category. These two are tentatively included here on the basis of their exposed surface area. One (Feature 47) is mentioned above. The other (Feature 46) was located about 20 m west of the excavation block in a cluster of three features with a medium-sized, bell-shaped pit (Feature 41) located to the southeast and a possible small, basin-shaped pit (Feature 45) to the south.

In Component 2, Feature 26 was located about 1 m north of the edge of a pit structure (Feature 16). Also in this component, Feature 36 was one of a cluster of four features (with Features 37, 38, and 39) located about 2 m southwest of the same pit structure. Within this cluster, this pit was the southernmost and associated with a small, oxidized, basin-shaped pit (Feature 37) and two irregular, shallow depressions (Features 38 and 39). These probably represent an exterior use area associated with the pit structure.

In Component 3, Feature 28 was one of a cluster of three features from an activity area not associated with a pit structure. Within this cluster, a medium, oxidized, bell-shaped pit (Feature 30) was located immediately northeast of Feature 28, and a medium, oxidized, basin-shaped pit (Feature 29) was closely associated to the southeast of Feature 28. Also in this component and located 1.5 m south of this cluster was Feature 35, the fourth in this sized subtype. All four features located within about 2 m² may represent an activity area composed of three types of features.

Small

The six small features recorded from the excavations (Features 2, 6, 20, 21, 25, and 34) were diminutive expressions of the larger pits. Their estimated volumes ranged from 1.5 liters to 5.7 liters. Two other features (Features 40 and 45) have been tentatively included in this category because of their small, exposed surface areas. Feature 40 may have been part of an activity area represented by three other features (Features 9, 12, and 13) in Component 3. Feature 45 was also exposed in a cluster of features (with Features 41 and 46) to which a component could not be assigned. The other small, unoxidized, basin-shaped pits were recorded from various contexts, some as isolated features and others with pit structures in both interior and exterior associations.

In Component 2, Features 21 and 25 were associated with a pit structure (Feature 16). Feature 21 was exterior to the pit structure, located about 1 m from its southeast edge, and Feature 25 was interior, situated in the northwest quadrant of the floor of the pit structure.

Also in this component, Feature 34 (Figure 6) was an isolated feature located about 8 m west of the same pit structure, in an exterior activity area composed primarily of a concentration of bone and fired rock.

In Component 3, Features 6 and 20 were associated with a pit structure (Feature 8). Feature 6 was located about 1 m from the eastern edge of the pit structure. Feature 20 was interior to the pit structure, situated in the center of the western portion of the floor. Feature 2 was an isolated feature, located about 4 m southeast of the pit structure in an area free of other features and cultural material from this component.

Irregular, Shallow Basins

The irregular, shallow basin category is composed of features that were very shallow and roughly circular to oval in shape. Their diameters were from five to eight times larger than their depths. Generally these features were poorly defined in the ground, primarily due to extensive rodent disturbance. Each of these five features was found in close association with other feature types. Three size grades were distinguished. Although Figure 7 illustrates a typical small feature of this type, the larger sizes are proportionately similar.

Large

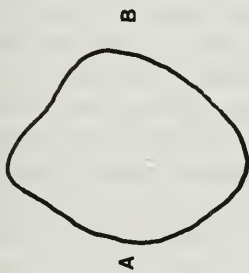
Feature 13 is the only large, irregular, shallow basin. It was located directly northwest of a large, oxidized, bell-shaped pit (Feature 12) and a medium, oxidized, basin-shaped pit (Feature 9). This cluster of features represents an activity area unassociated with pit structures from Component 3. Also located near Feature 13 were "two areas of charcoal stained sand" (Brechtel et al. 1984:138) documented about 1 m northeast in the Frontier pipeline trench and a possible small basin-shaped pit (Feature 40) exposed from blading for Exxon about 3 m southeast.

Medium

Two features (Features 18 and 39) of medium size were recorded from the excavations. Their average volume was almost one-third that of the large, irregular basin. In Component 2, Feature 39 was one of a cluster of four features (with Features 36, 37, and 38) located about 2 m in the southwest edge of a pit structure (Feature 16), representing an exterior activity area. In Component 3, Feature 18 was documented from the southwest quadrant of the floor of the pit structure (Feature 8) near a small, irregular basin (Feature 19).

Small

Two small features (Features 19 and 38) were recorded. Their average volume was almost one-fifth that of the medium, irregular basins. In Component 2, Feature 38 (Figure 7) was one of a cluster of four features (with Features 36, 37, and 39) from an exterior use area located about 2 m southwest of a pit structure (Feature 16). In Component 3, Feature 19 was the fourth feature, located in the southwest quadrant of the pit structure (Feature 8) floor.

MIDDEN/ROCK CONCENTRATION
FEATURE 15

HORIZONTAL PLAN VIEW



0 10 20
CM

HORIZONTAL PLAN VIEW

Elv.
99.45 M

CROSS SECTION

0 10 20 30
CM

● - FIRED ROCK

Figure 7. Illustrations of a typical irregular, shallow basin and midden/rock concentration from the Buffalo Hump site.

Midden/Rock Concentrations

The midden/rock concentration feature was characterized as a discrete concentration of fired sandstone, bone, and lithic debitage within a shallow, amorphous, charcoal-stained matrix of variable size and shape. Only discrete concentrations with defined limits were recorded as features of this type. Other areas contained concentrations of similar content, such as the area adjacent to the southeast edge of Feature 8 and the area around Feature 34, but feature designations were not assigned to these areas because of their poor definition due to the wide dispersion of cultural material. All four features of this type were recorded from Component 2.

Feature 1, the smallest of this type, was a discrete cluster of fired sandstone pieces located a meter south of a small, unoxidized, bell-shaped pit (Feature 3) and a meter southwest of a medium, oxidized, basin-shaped pit (Feature 7). All three of these features were located within 2 m of the southwestern edge of a pit structure (Feature 27). Two other midden/rock concentrations (Features 11 and 22) were recorded over 2 m south of this same pit structure and 4 m east of the other pit structure (Feature 16) from Component 2. Feature 11 was originally assigned to a concentration of fired sandstone situated on the eastern edge of a large, roughly circular, shallow charcoal stain (Feature 22). Once Feature 11 was documented and removed, the limits of Feature 22 were defined below it. These two features may be described more accurately as one midden/rock concentration. The size and shape of Feature 22 exhibited similarities to the bottom limits of the other pit structures, however, excavation of the dark matrix revealed such poorly defined, amorphous boundaries that it could only be designated as a midden concentration.

Feature 15 (Figure 7) was located adjacent and exterior to the southeast edge of the other pit structure (Feature 16) from Component 2. The area designated as Feature 15 was the most dense, deepest defined portion of the midden concentration. Similar materials within a charcoal-stained matrix were situated to the south and east of the defined feature in less concentrated quantities. Minor amounts of lithic debitage, fragmented bone, and some groundstone fragments were recovered from the larger midden concentration among pieces of fired sandstone.

A fifth midden concentration may be represented by Feature 43, which was exposed during blading for the Exxon pipeline. Feature 43 was located about 10 m east of a pit structure (Feature 27) from Component 2. Due to the location and context of Feature 43, no component association could be made. Like Feature 22, it may have been the bottom remains of a pit structure, but lack of further evidence prohibited its definition as such. A small, oxidized, basin-shaped pit (Feature 44) was located inside the northwestern edge of Feature 43. This may have been an activity area represented by a hearth (Feature 44) and midden (Feature 43) deposited downwind from the former.

FUNCTIONAL INTERPRETATIONS OF FEATURES

Functional interpretations of the various types of features are derived through examination of attributes such as content of the fill

and associations with other features and exterior cultural materials. Another valuable, interpretive tool is the use of analogies from ethnographic sources as well as from modern replicative experimentation. Also taken into consideration are other attributes inherent in the morphological classification, such as size, shape, volume, and presence or absence of oxidation. Table 2 presents the relevant data for each feature recorded during excavation, with primary attention to the contents of the feature. Other quantitative data pertinent to interpretation of function can be found in Table 1.

In the following discussion, each of the morphological types is examined, and functional interpretations are offered for each type. Functional explanations unique to individual features are also incorporated in the discussion.

Pit Structures

In the most general sense, the attributes of size and associated interior and exterior features suggest that pit structures represent the remains of intensive activity. Consideration of the distribution of cultural material, which is concentrated in greater densities outside the margins of the pits than inside, indicates the presence of some type of physical or behavioral barrier around the pits. Although no evidence of superstructures was recovered, the clear distinction between interior and exterior concentrations of the cultural material argues strongly for a physical barrier around the pit structures. The uniformity and definitions of the basal and peripheral margins of the pits indicate that they were originally constructed intentionally as predetermined forms. Specifically, the pit structures appear to be the remains of housepits, or shelters, which were composed of shallow, excavated pits over which light, domed or conical superstructures were built, probably of sagebrush.

The pattern is analogous to descriptions in the ethnographic literature of some of the houses constructed by the various groups of Shoshone and Ute who occupied the Wyoming Basin and adjacent areas (D'Azevedo 1986). Among these groups, summer dwellings were composed primarily of roofless brush windbreaks and sunshades without walls that were built on the unmodified ground surface. Their winter houses were of more substantial construction, domed or conical shelters made of poles covered with reeds, grass, bark, brush, hides, or any other convenient materials. A hearth was placed inside, near the center, in a small pit or on the unprepared ground surface. The incorporation of a shallow, excavated pit to produce a semisubterranean dwelling was not practiced universally but was common among some groups. When semisubterranean houses were built, they were excavated about 50 cm deep and had diameters ranging from 2.5 to 5 m. A light pole and brush superstructure was erected over the pit and was anchored down by piling soil from the excavated interior around its lower edges. Other than the excavated pit, this type of construction would not necessarily leave archaeologically visible evidence, such as post holes. Evidence that sagebrush was a common construction material is provided by Captain Bonneville in his description of Digger or "Shoshokoe" dwellings as "a sort of break-weather, about three feet high, composed of sage (or wormwood), and erected around them in the shape of a half moon" (Irving 1854:259). Although this description provides little detail about the

Table 2. Qualitative data on features' contents from the Buffalo Hump site.

Feature Type Subtype Size grade	Feature Number	Fired Rock		Lithic Debitage Number	Faunal Remains (taxa represented)	Artifacts	Plant Remains			Component
		Number	Weight				Charred seeds	Pollen	Types	
Pit structure	8	12	+	-	-	1 GS frag- ment 1 misc. bone	291 goosefoot 39 povertyweed 2 sedge 2 Indian ricegrass 1 mustard 1 sagebrush 1 sunflower 1 Utah juniper 4 unknown	Cheno-am and aggregates, High-spine Compositae, grass		3
	16	27	2360.8 g	15	Small to medium mammal	9 GS slab fragments 1 bone awl	1063 goosefoot 113 povertyweed 65 mustard 5 sedge 2 sunflower 1 grass	Cheno-am and aggregates		2
	27	9	2270.0 g	4	Small to medium mammal Medium to large mammal	-	277 goosefoot 32 povertyweed 28 mustard 8 sunflower 3 saltbush	Cheno-am and aggregates		2
Bell-shaped pit Oxidized Large	12	4	+	7	Jackrabbit Small to medium mammal Medium to large mammal	-	2 goosefoot 1 beeweed 1 Indian ricegrass	Insufficient count		3

Table 2. Continued.

Feature Type Subtype Size grade	Feature Number	Fired Rock		Lithic Debitage Number	Faunal Remains (taxa represented)	Artifacts	Plant Remains		Component
		Number	Weight				Charred seeds	Pollen Types	
Bell-shaped pit Oxidized Large (continued)	17	10	8626.0 g	-	-	-	826 goosefoot 117 povertyweed 33 mustard 5 sedge 3 sagebrush 2 grass	Cheno-am and aggregates	3
	23	4	+	-	-	-	14 goosefoot 1 sedge 1 unknown	Sample not analyzed	2
	24	20	34,504.0 g	2	-	2 CS slab fragments	4241 goosefoot 1459 mustard 190 povertyweed 135 saltbush 81 sedge 54 grass 27 sagebrush 27 unknown	Sample not analyzed	2
Bell-shaped pit Oxidized Medium	30	40	14,755.0 g	-	-	-	3 goosefoot	Insufficient count	3
	Bell-shaped pit Unoxidized Small	3	-	-	-	-	-	Sample not analyzed	2
33		-	-	-	-	-	486 goosefoot 65 povertyweed 30 mustard 8 sedge	Sample not analyzed	2

Table 2. Continued.

Feature Type Subtype Size grade	Feature Number	Fired Rock		Lithic Debitage Number	Faunal Remains (taxa represented)	Artifacts	Plant Remains		Component
		Number	Weight				Charred seeds	Pollen Types	
Bell-shaped pit Unoxidized small (continued)	33						7 saltbush 1 sagebrush		
Basin-shaped pit Oxidized Large	4	-	-	-	-	-	12 beeweed 2 goosefoot	Cheno-am, grass, beeweed, sage- brush	1
Basin-shaped pit Oxidized Medium	7	3	+	-	-	-	8 goosefoot	Cheno-am	2
	9	-	-	2	Jackrabbit Medium to large mammal	-	1 beeweed	Cheno-am and aggregates, sawatch knot- weed	3
	14	2	-	-	Medium to large mammal	-	81 goosefoot 4 sedge 1 grass 1 unknown	Sample not analyzed	2
	29	3	+	-	Rodent Small to medium mammal	3 bone tubes	3 unknown	Insufficient count	3
Basin-shaped pit Oxidized Small	37	-	-	-	-	-	3 Indian rice- grass 2 grass	Cheno-am and aggregates,	2

Table 2. Continued.

Feature Type Subtype Size grade	Feature Number	Fired Rock		Lithic Debitage Number	Faunal Remains (taxa represented)	Artifacts	Plant Remains		Component
		Number	Weight				Charred seeds	Pollen Types	
Basin-shaped pit Oxidized Small (continued)	37						2 goosefoot 8 unknown	grass and aggregates, buckwheat	
Basin-shaped pit Unoxidized Medium	26	9	170.4 g	-	Jackrabbit	-	7 beeweed 5 goosefoot	Insufficient count	2
	28	2	170.4 g	-	-	-	-	Sample not analyzed	3
	35	10	+	5	Small to medium mammal Medium to large mammal	-	1 phacelia	Sample not analyzed	3
Basin-shaped pit Unoxidized Small	36	18	2360.8 g	-	Medium to large mammal	1 juniper seed bead	5 sagebrush 4 Indian ricegrass 2 grass 2 beeweed 1 goosefoot 1 phacelia	Cheno-am and aggregates, grass	2
Basin-shaped pit Unoxidized Small	2	5	+	-	Medium to large mammal	-	-	Sample not analyzed	3
	6	3	+	-	-	-	39 goosefoot 2 povertyweed	Sample not analyzed	3

Table 2. Continued.

Feature Type Subtype Size grade	Feature Number	Fired Rock		Lithic Debitage Number	Faunal Remains (taxa represented)	Artifacts	Plant Remains		Component
		Number	Weight				Charred seeds	Pollen Types	
Basin-shaped pit Unoxidized Small (continued)	20	-	-	-	Medium to large mammal	-	30 goosefoot 3 povertyweed 1 unknown	Sample not analyzed	3
	21	1	+	-	-	-	163 goosefoot 9 povertyweed 5 mustard 1 sunflower 1 grass 4 unknown	Sample not analyzed	2
	25	-	-	-	-	-	262 goosefoot 46 povertyweed 15 saltbush 1 sedge	Sample not analyzed	2
Irregular, shallow basin Large	34	5	-	-	Medium to large mammal	-	4 grass 2 Indian rice- grass 2 phacelia	Cheno-am and aggregates, nightshade, grass	2
	13	1	+	2	Medium to large mammal	-	1 goosefoot 1 unknown	Cheno-am and aggregates	3
Irregular, shallow basin Medium	18	-	-	-	-	-	35 goosefoot 3 mustard 1 grass	Sample not analyzed	3
	39	-	-	-	Medium to large mammal	-	-	-	2

Table 2. Concluded.

Feature Type Subtype Size grade	Feature Number	Fired Rock		Lithic Debitage Number	Faunal Remains (taxa represented)	Artifacts	Plant Remains		Component
		Number	Weight				Charred seeds	Pollen Types	
Irregular, shallow basin Small	19	-	-	-	-	-	18 goosefoot 2 povertyweed 2 mustard	Sample not analyzed	3
	38	3	+	+	Rodent, Small to medium mammal, Medium to large mammal	-	2 unknown	Sample not analyzed	2
Midden/rock concentration	1	20-25	+	-	-	1 bone tube	Not sampled	Not sampled	2
	11	24	4540.0 g	2	-	2 bone tubes	Not sampled	Not sampled	2
	15	72	1362.0 g	-	-	-	79 goosefoot 3 sunflower 2 beeweed	Cheno-am aggregates, sagebrush	2
	22	11	+	7	-	1 bone awl 1 bone tube 1 bone tube discard	Not sampled	Not sampled	2

Key: - = absence
+ = no quantity given
GS = groundstone

characteristics of the dwellings, it is significant to note that Bonneville encountered the group in January, so he was describing their winter houses.

A similar pattern may be reflected in some archaeological sites from the Early Archaic period in southwestern and central Wyoming. At least a dozen sites have been documented recently which have evidence of the remains of analogous pit structures (Eakin 1984; Harrell and McKern 1986; Newberry and Harrison 1986; McGuire et al. 1984). In most sites, evidence of the season of occupation is absent or not yet analyzed; others appear to have been occupied in summer or fall (McGuire et al. 1984; Newberry and Harrison 1986). But at the Maxon Ranch site, evidence in the faunal remains indicates winter or early spring occupations of two pit structures from Early to Middle Archaic components (Harrell and McKern 1986). Due to differences in time, cultural remains, and other attributes, however, it is difficult to relate these Early Archaic pit structures to those at Buffalo Hump from Late Prehistoric period occupations.

More similarities may be apparent in the possible structural remains from a Late Prehistoric period occupation at the Taliaferro site, located about 140 km west of Buffalo Hump (Smith 1987c). At the Taliaferro site, a small, very shallow, circular depression was documented from a component dating to 1170 years ago. Although the feature did not show the degree of definition and uniformity of the Buffalo Hump pit structures, a similar distribution of cultural debris was apparent, where distinctly greater exterior concentrations were documented in marked contrast to the paucity of material from the interior of the feature. At the Taliaferro site, evidence in the faunal remains indicated a wide range of season of occupation, from spring through fall. But like the Buffalo Hump site, thousands of charred seed remains were recovered, suggesting exploitation of plant resources available only in summer and early fall or from stored supplies.

The abundance of charred seeds and the pollen evidence from the pit structures and associated features (Table 2) at Buffalo Hump may reflect a late summer to fall occupation. If this were the case, the construction of pit structures for shelter would have been for purposes other than insulation against harsh weather conditions. Presently strong winds are common in the vicinity year-round, and there is evidence that similar conditions persisted in the past for several thousand years (see Appendix F). In order to process seeds efficiently in such windy conditions, it would be necessary to make use of windbreaks by creating shelters. At Buffalo Hump, the available construction material for shelters was probably in the form of low bushes such as sagebrush, saltbush, and greasewood, as is presently the case. The absence of poles would diminish the capability to construct a shelter of sufficient height to accommodate individuals engaged in seed processing activities. The excavation of a shallow pit would increase the vertical space in a shelter constructed of the available brush.

Another interpretation of the pit structures is that the depressions were created through intensive use rather than by intentional construction. In this case, brush shelters may have been placed on the unprepared ground surface and trampling, combined with periodic cleaning of the interiors, may have eventually formed the shallow pits in the loose, sandy soil. However, the size and uniformity of the pit structures suggest intentional construction of predetermined forms. A

third explanation is that the pit structures actually do reflect a pattern analogous to the winter houses used by historic groups. In this case, the presence of the charred seeds may be indicative of stored supplies stockpiled in the large, bell-shaped pits in the interior of the structures.

Bell-shaped Pits

Traditionally in the archaeological literature, bell-shaped pits have been presumed to represent storage and/or processing of both plant and animal resources. Large, deep, cylindrical and bell-shaped cache pits with sharply constricted openings have been documented from historic and prehistoric sites on the Great Plains to the east (Wedel 1961). Similarly shaped baking pits with heavily burned walls and floors have also been recorded from Plains cultures (Wedel 1961:112). Generally these cache and baking pits have been found in association with village sites whose inhabitants practiced agriculture and used them primarily to store and cook corn. Bell-shaped pits are rare from archaeological sites in Wyoming. With the exception of the Buffalo Hump site, only three other sites have recorded pits of similar shape and size. Two sites (48LN1296 and 48LN1404) are located about 140 km west of Buffalo Hump, and at least one (48LN1296) represents a Late Prehistoric occupation. The author personally observed bell-shaped pits as they were documented at these sites. The third site (Crooks), located about 60 km northeast of Buffalo Hump, had two bell-shaped pits documented from the interior of a pit structure dating to 4850 years ago (McKern 1987).

With such paucity of comparative literature, it is necessary to examine these bell-shaped pits as they occurred at the Buffalo Hump site. A significant trait of the large and medium pits is the presence of oxidation on their sides. In 1985, a replicative experiment was undertaken at the site to determine the oxidation potential of the soil (Newberry et al. 1986:30). The results demonstrated that oxidation was quickly produced at relatively low temperatures due to the high iron content in the soil. With this consideration, the extensive bands of oxidation on the walls of the larger pits would not have required prolonged, extreme heat to be produced. However, their very presence indicates that heat was introduced into the pits at some point, probably as fire or coals. This attribute suggests that the pits were used for cooking or processing. An outstanding attribute of the two large pits (Features 17 and 24) from inside two of the pit structures is the large quantities of charred seeds from their interiors. The other large and medium pits also contained seeds, but in minor amounts. This evidence, combined with the presence of oxidation, suggests that these pits were used to bake or roast edible seeds; or more likely, the cakes made from meal produced by grinding the seeds. However, the traditional view of bell-shaped pits as storage cists is not simply negated by this evidence. The pits may have been used originally to store the seeds or cakes, which were roasted either before or after storage in the same pit. Sandstone slabs with which to cover the pits to protect stored items and create more floor space in the case of the pits within structures are abundantly available in the immediate vicinity of the site. One such slab was recovered from within one of the exterior, large pits (Feature 12). With the exception of Feature 23, all of the

large and medium pits contained smaller, fired rocks, which are commonly used in roasting pits to enhance and maintain heat.

The small, bell-shaped pits may have served slightly different functions. The absence of oxidation suggests that fire was not introduced directly into the pits. They may have been smaller storage cists which were never used for roasting. Their locations near other oxidized pits may indicate their use as auxiliary pits which served to hold substances before their processing or as boiling pits if lined with hides.

Basin-shaped Pits

Basin-shaped pits are the most common type recorded from prehistoric sites of all ages in the area. Because the shape is very basic and easy to create, this type of feature was probably used variably for a number of functions. At the Buffalo Hump site, oxidation appears to be a significant attribute indicative of function. The oxidized pits of this type must have had heat directly introduced into their interiors. These oxidized pits may have been the hearths in which coals were produced to be used in the various other processing and/or roasting pits. Most of these pits were closely associated with other types of features, the groups of which may represent processing of plant and/or animal resources. Charred seeds were recovered from all of the oxidized pits of all sizes (Table 2), which indicate that plant processing may have been a common denominator of their functions. Cooking or rendering of animal food sources appears to have been practiced along with plant processing in three of these pits from which minor amounts of fragmented bone were recovered. The pits which contained minor amounts of both seeds and bone may have been used simply as hearths for preparing daily meals.

The unoxidized, basin-shaped pits were probably used for a variety of purposes as auxiliary components of processing activities. The absence of oxidation indicates that heat was introduced either indirectly as rapidly cooling ashes or hot rocks or not at all. Another possibility is that these pits were lined with hides, rocks, or other materials which were removed after use. The amounts of charred seeds and animal bones from these pits (Table 2) are similar to those from the oxidized pits and probably indicate similar functions. Most of these unoxidized pits were also found in groups with other feature types, representing activities which required the incorporation of several different types of features.

The medium-sized, unoxidized pits contained more fired rocks than the small, unoxidized pits and all the oxidized features of this type. These features may have been used as roasting pits, in which heat was produced by the introduction of hot rocks.

Irregular, Shallow Basins

The poor definition, variable shapes, and overall ephemeral nature of the irregular, shallow basins suggest that they were not prepared pits. It is more likely that these features were created by deposition of charcoal and ash on the unprepared ground surface. It is also possible that some of these may have been basin-shaped pits which were so disturbed by rodent burrows that their definition is lost. All of

these basins were situated within groups of other feature types. Given their associations within these groups, it is possible that this type of feature represents the remains of cleaning out hearths and roasting pits for reuse, or for recovery of the processed materials.

Midden/Rock Concentrations

Midden/rock concentrations may have been produced by means similar to the irregular, shallow basins. Their size and content reflect more intensive, or prolonged, use as loci for deposition of refuse from generalized cleaning, including the emptying of hearths and pits. The smallest rock concentration (Feature 1) was probably produced when one or both of the two nearby pits was emptied of its contents. The other three midden/rock concentrations are extensive and dense enough to indicate longer, intensive use as a result of a number of cleaning incidents. The one (Feature 15) located adjacent to a pit structure (Feature 16) may have accumulated from periodic cleaning of the structure's interior floor and pits, and possibly from refuse produced in the nearby exterior features. The other concentration (Features 11 and 22) may have accumulated from similar activities associated with the other pit structure (Feature 27) and its external features. This larger concentration may also have been a designated dump area to accommodate the refuse from both pit structures in this component.

Summary

The following general functional interpretations are proposed for each of the feature types:

1. Pit structures functioned as shelters for habitation and/or specific activities, primarily for processing and stockpiling seeds. Shallow pits were required as components of the shelters to produce more vertical space in structures constructed of brush, probably sagebrush.
2. Bell-shaped pits served as short-term storage facilities and roasting ovens, primarily for seeds of wild, edible plants and the cakes made from the meal of ground seeds.
3. Basin-shaped pits were used for a variety of functions, those with oxidation as hearths and roasting pits and those lacking oxidation as auxiliary containers which were either lined, filled with sources of indirect heat, and/or used without heat.
4. Irregular, shallow basins were produced by deposition of the contents from nearby hearths and pits onto unprepared ground surfaces or by rodent disturbance of features that were originally basin-shaped pits.
5. Midden/rock concentrations represent accumulations of refuse from cleaning out pit structures and their associated hearths and pits.

APPENDIX B

Artifact Analysis

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The artifacts recovered from the Buffalo Hump site are varied in nature yet relatively small in number. The total sample is composed of 794 artifacts, of which 701 are specimens of lithic debitage. The remainder consists of 31 flaked lithic tools, 38 fragments of groundstone, 22 specimens of modified bone, one shell artifact, and one bead made from a juniper seed. The majority of these artifacts were associated with Components 2 and 3. Only minor amounts of lithic debitage were recovered from Components 1 and 4. One biface blank from a test unit could not be assigned to a component. Following a brief description of the methods applied to their analysis, each of the five classes of artifacts is discussed and the results presented.

METHODS

The methods used to analyze each class of artifact varied according to the nature of the class, although some basic principles were applied to all. Generally, the analytical methods followed those outlined in the Project Treatment Plan (Creasman et al. 1985). Within this framework, three phases, or aspects, of analysis are recognized: morphology, technology, and function.

Analysis began with the distinction of morphological types through visual or qualitative groupings of similar artifacts on the basis of attributes of style. Thus, types, such as flake, biface, tabular groundstone, and bone tube, were produced. Under this system, an effort is made to avoid functional type names and connotations. However, some functional labels were incorporated because the morphologically descriptive terms for some types would be so long and cumbersome that their meaning would be lost. Also, certain terms were used because they are recognized by the larger archaeological community as formal type names. For these reasons, this analysis used the functional terms projectile point, drill, mano, bone awl, and bead to refer to morphological types. Ideally these stylistic types derived through qualitative examination should be subjected to quantitative tests to check their validity. In the case of this sample, which contains minor amounts of the more formal types such as projectile points, no such tests were applied due to the insufficient sample size.

After the morphological types were established, consideration of the technology that produced them led to the distinction of more refined types. This analytical framework made use of an idealized model of a lithic reduction sequence to define the technological types. This model depicts a continuum of stages through which an individual artifact potentially may progress to reach its end form. Any one artifact may represent any number of variations in the technological continuum, and the distinction of the type stages is somewhat arbitrary. However, the model serves to illustrate a sequence of lithic reduction from which technological types, such as core, preblank, and blank, are defined. In a very general sense, this type of technological classification may be viewed as a relative measure of energy expended to produce an artifact with those from the earliest stages requiring the least amount of energy.

Although this technological classification was designed for applied to groundstone and modified bone. In both classes of artifacts, analysis of flaked lithic artifacts, the same general principles may be

the degree of modification from manufacture and/or use increases with the amount of energy expended to produce an artifact. For example, a naturally flat tabular stone or a pointed splinter of bone may be used successfully without further modification. These reach the archaeological record as artifacts classified technologically as expedient tools from preliminary technological stages. At the other end of the scale, a mano that was modified and shaped by pecking and a polished bone disk bead require time and energy to produce the end form. Technologically, these would represent formal tools from terminal stages of manufacture. Ideally, at least in the case of the bone bead, intermediate stages would be represented by discarded failures or the byproducts of manufacture.

The byproducts of manufacture may themselves be analyzed in terms of the general technological stage at which they were produced. For bone specimens, however, specific technological stages of the byproducts of manufacture are not distinguished because of the modest representation of relevant data.

The lithic debitage is classified according to three general technological stages. Primary flakes produced in preliminary decortication stages have at least 90% cortex on their dorsal surfaces. Secondary flakes from intermediate stages have 1% to 90% cortex on their dorsal surfaces, and tertiary flakes from the final stages lack cortex entirely. Biface thinning flakes are distinctive tertiary flakes that display a lipped, double-faceted platform and show evidence of crossing at least one half of the face of the artifact from which they were removed. Pieces of chunky or blocky debitage that lack the attributes of flakes, i.e., striking platform and bulb of force, are classified as shatter and may be produced at any stage. Debitage included as tested material are cobbles, pebbles, or pieces of raw material from which three or fewer flakes have been removed. Size grades are applied to all types of flakes, primarily as a means of refining the technological classification. Microflakes are less than 1.5 cm in maximum length and submicroflakes are less than 0.7 cm in length. These smaller flakes are considered to be a reflection of the terminal stages of tool production, when tool edges are refined during final shaping, or indicative of postmanufacture stages as a result of rejuvenation of tool edges worn from use or attrition from use-wear.

Functional analysis of the morphological and technological types is conducted as a final step. Generally, analysis of function is based on microscopic examination of traces of wear with comparison to archaeological specimens and tools produced and used in modern replicative experiments or by modern hunters and gatherers. Such studies are most common for flaked lithic artifacts and bone and are rare for groundstone. For most of the groundstone and bone artifacts in this study, determination of function was primarily intuitive, based on gross morphological attributes. For the flaked lithic tools, no formal, comprehensive analysis of microscopic traces of wear was performed because of the restricted scope of research. However, cursory, low-power (10x-20x) microscopic examination of each tool was conducted during the course of the analysis. As a result, the traces of use-wear observed on tools were recorded in descriptive terms and then correlated with the specific actions that have been shown to produce them (Ahler 1971; Hayden 1979; Keeley 1974; Tringham et al. 1974).

ARTIFACT DESCRIPTIONS

Flaked Lithic Artifacts

A total of 731 flaked lithic artifacts was recovered from the excavations: 701 pieces of debitage, 8 cores, and 22 flaked stone tools. Only Components 2 and 3 produced tools. These consist of 3 utilized flakes, 3 retouched flakes, 1 biface preblank, 1 biface blank, one drill, 3 hafted biface/knives, and 10 projectile points, including complete and incomplete specimens. Debitage was recovered from all four components.

These artifacts were classified into formal types using technological and morphological traits. Generally, functional types are not implied. The exceptions were projectile points, knives, and drills where functional labels were used as a convention to distinguish these types. The analytical discussion begins with a description of the lithic raw material types represented in the collection. The discussion of the artifacts is presented in an order that follows the technological sequence of tool production, from debitage through projectile points.

Raw Material Types

The lithic raw materials were sorted into five classes of material types: authigenic chert, biogenic chert, oolitic chert, dendritic opal, and metaquartzite. These types of lithic source material were defined by J. C. Miller (1986b) and are summarized below.

Authigenic chert is a type of chert that was formed in situ and contemporaneously with the surrounding matrix. The varieties range from siliceous mudstones and siltstones to nearly pure, amorphous silica rock and include all amorphous opaque and translucent cherts. This type of chert formed in stagnant or isolated basins associated with the Bridger Formation and/or the Knight Formation.

Biogenic chert is related to some biologic origin, either through replacement of the organisms' original material or through biologic activity as represented in ichnofossils. In replacement varieties of biogenic chert, the terms stromatolitic, algalitic, and fossiliferous chert are used to differentiate more specific origins. These materials are associated with the Bridger Formation and/or the Tipton and Laney members of the Green River Formation.

Oolitic chert is a chert in which silica has replaced the calcium carbonate accretionary spheres (ooids or oolites). This material type is most commonly found in littoral lacustrine facies of the Laney and Tipton members of the Green River formation.

Dendritic opal includes chalcedony, agates, and opals. Chalcedony and agate are cryptocrystalline varieties of near pure silica (SiO_2 - silicon dioxide). Both exhibit fibrous internal features from crystal intergrowth and form in low to moderate hydrothermal dissolutions. Opal is also a dissolution product, but from extremely low temperatures. It does not possess the fibrous intergrowths. The area of primary occurrence for this material type is the Bridger Formation.

The last lithic raw material recovered at the Buffalo Hump site is a metaquartzite. Metaquartzite is the result of heat and pressure on quartz sandstone, orthoquartzite, previous metaquartzites, or any other high silica rock. This material type is distinguished by its lack of rounded (sedimentary) grains, prevalence of accessory fractures on a

fracture plane, and the presence of microscopic quartz crystals. This rock is Precambrian in age and can be found as lag cobbles on the tops of most ridges in southwest Wyoming.

This type of classification scheme for lithic source material was developed in an attempt to reduce some of the confusion inherent in previous systems. In the past, lithic source materials were commonly named after the first locality from which they were found (i.e., Granger Green, Lonetree chert, Black Mountain chert, Black Buttes quartzite). These names infer specific point localities when, in reality, most of the material types have much wider distributions. With the approach used in this analysis, lithic material types are associated with the formal rock units in which they were formed. By doing this, more realistic boundaries and localities may be defined. This information is essential for understanding settlement, subsistence, and trade of the aboriginal populations in southwest Wyoming. The lithic raw materials recovered from the excavations at the Buffalo Hump site suggest that all of the material could have been collected locally, within a radius of less than 10 kilometers.

Lithic Debitage

A total of 701 pieces of lithic debitage was recovered from the four cultural components at the Buffalo Hump site. Components 1 and 4 yielded very small amounts of debitage (Tables 1 and 2). These small amounts may reflect (1) inadequate sampling of the components, (2) very short-term occupations, or (3) limited use and manipulation of lithic resources. Because of the inadequate sample sizes, the debitage from these two components was not incorporated in the interpretive discussion presented below for Components 2 and 3.

Component 2 yielded a total of 323 pieces of lithic debitage representing five types of lithic raw material and all stages of reduction (Table 3). The dominant material types are authigenic cherts, representing 54% of the component total, and biogenic cherts, representing 32%. The primary decortication flakes represent 7% of the total assemblage. Thirty-eight percent of the primary reduction stage is represented by microflakes. All of the microflakes are authigenic chert, suggesting that this type of source material may have been acquired in the form of small cobbles or pebbles. Secondary decortication flakes represent 33% of the total. Of the secondary reduction stage, 40% is represented by micro- and submicroflakes. Again, the large percentage of microflakes from this category suggests that the source of raw material was in the form of small cobbles. Tertiary flakes represent 52% of the total. Microflakes represent 42% and submicroflakes 8%. This type of reduction sequence is indicative of preliminary tool reduction.

Although 42% of the total lithic assemblage is represented by micro- and submicroflakes, only 2% are biface thinning flakes and 5% are submicroflakes. These last two categories are usually indicative of final tool manufacturing or tool maintenance. The low frequencies of these types suggest that these activities were not emphasized, at least within the area of excavation. The results of the analysis of the lithic debitage recovered from Component 2 suggest that the raw lithic materials were collected from the area surrounding the site locality, were brought back to the site, and were used to produce a limited number of preliminary tool forms (blanks and preforms). The evidence does not

Table 1. Summary of lithic debitage from Component 1 at the Buffalo Hump site.

Reduction Stage	Raw Material				Total
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Meta-quartzite	
Secondary flake fragment	1	1	-	-	2
Tertiary flake	2	-	1	-	3
Tertiary flake fragment	-	1	-	-	1
Tertiary microflake	1	-	-	1	2
Biface thinning flake	1	-	-	-	1
Total	5	2	1	1	9

Table 2. Summary of lithic debitage from Component 4 at the Buffalo Hump site.

Reduction Stage	Raw Material				Total
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Meta-quartzite	
Secondary flake	-	-	1	-	1
Secondary microflake	1	-	-	-	1
Tertiary flake	2	1	-	-	3
Tertiary microflake	1	-	-	1	2
Tertiary flake fragment	1	-	-	1	2
Shatter/Chunk	-	1	-	-	1
Total	5	2	1	2	10

indicate that final tool forms (projectile points, biface/knives) were manufactured within this area of the site.

A total of 359 pieces of lithic debitage was recovered from Component 3 (Table 4). The dominant material types are biogenic cherts, representing 45% of the total assemblage, and authigenic cherts, representing 37%. All five types of raw materials defined above are represented in the assemblage. Primary decortication flakes represent 12% of the total assemblage. Of the primary reduction stage, 29% is represented by microflakes. Secondary decortication flakes represent 30% of the total assemblage with 31% of the secondary reduction stage represented by microflakes. Tertiary flakes represent 51% of the total assemblage. Of the tertiary reduction stage, 44% is represented by microflakes and 2% by submicroflakes. Bifacial thinning flakes represent only 3% of the total assemblage. This reduction sequence is very similar to that characterized in Component 2. Analysis of the lithic debitage recovered from Component 3 suggests that small cobbles of lithic raw material were collected from around the general vicinity

Table 3. Summary of lithic debitage from Component 2 at the Buffalo Hump site.

Reduction Stage	Raw Material					Total	Per- cent of total	Percent of total by tech- nological stage
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Dendritic Opal	Meta- quartzite			
Primary flakes	3	4	-	2	-	9	3%	
Primary microflakes	9	-	-	-	-	9	3%	8%
Primary flake fragment	3	1	1	1	-	6	2%	
Secondary flake	26	16	4	2	1	49	15%	
Secondary microflake	25	11	1	4	-	41	13%	33%
Secondary submicroflakes	2	-	-	-	-	2	1%	
Secondary flake fragments	4	7	2	-	-	13	4%	
Tertiary flake	24	26	7	1	2	60	18%	
Tertiary microflake	41	20	1	10	-	72	22%	
Tertiary submicroflake	10	1	-	2	-	13	4%	52%
Tertiary flake fragment	14	8	2	4	-	28	8%	
Biface thinning flake	4	1	-	1	-	6	2%	2%
Shatter/Chunks	6	7	-	-	-	13	4%	4%
Tested material	1	1	-	-	-	2	1%	1%
Total	172	103	18	27	3	323	100%	100%
Percent of total	54%	32%	5%	8%	1%	100%		

of the site locality and brought back to the site. These cobbles were then worked to produce preliminary tool forms. Final tool manufacturing or maintenance was performed either at another area of this site or at another locality altogether.

Although some of the specimens collected from each of the components exhibit indications of thermal alteration, the small frequencies seem to indicate that this occurred after the flakes were discarded. There is no indication of thermal alteration of the raw materials prior to manipulation. Analysis of the flaked stone tools, lithic debitage,

Table 4. Summary of lithic debitage from Component 3 at the Buffalo Hump site.

Reduction Stage	Raw Material					Total	Percent of Total	Percent of total by technological type
	Authigenic Chert	Biogenic Chert	Oolitic Chert	Dendritic Opal	Meta-quartzite			
Primary flake	10	12	3	-	2	27	8%	
Primary microflake	4	4	4	-	-	12	3%	12%
Primary flake fragment	2	1	-	-	-	3	1%	
Secondary flake	20	32	11	-	-	63	18%	
Secondary microflake	16	14	2	2	-	34	9%	31%
Secondary flake fragment	4	6	2	-	1	13	3%	
Tertiary flake	20	30	12	-	1	63	18%	
Tertiary microflake	36	35	5	3	2	81	23%	
Tertiary submicroflake	1	2	-	-	-	3	1%	50%
Tertiary flake fragment	11	14	7	1	1	34	9%	
Biface Thinning flake	3	3	2	1	-	9	3%	3%
Shatter/Chunk	5	7	1	-	-	13	4%	4%
Tested material	1	2	-	-	1	4	1%	
Total	133	162	49	7	8	359	100%	
Percent of Total	37%	45%	14%	2%	2%	100%		

and groundstone suggests that the primary activity associated with the area that was excavated, at least within Components 2 and 3, was not tool manufacture. The paucity of lithic debitage suggests that this activity was not emphasized in this area of the site.

Cores

This type of artifact consists of a cobble of lithic raw material that has had a number of flakes removed. A core can be used as a source for flakes to be modified subsequently as various tool forms, or the core itself may be used to produce any one of a number of tool types. The various types of cores are defined by the specific technological manipulations used to produce them. Eight cores were recovered. These represent four types. All of these cores were recovered from Component 3.

Discoidal Cores

A discoidal core is a biconvex core having flakes or blades removed from the perimeter and usually on both faces. Three specimens of this type were recovered. Two of these cores (FFB18.16 and FFB18.304) are made from a stromatolitic chert and the other (FFB18.379) is an oolitic chert (Figure 1a).

Bidirectional Cores

A bidirectional core is a core which bears flake scars resulting from flakes or blades having been detached from two directions. One of this type of core (FFB18.380) was recovered and it is made from an algalitic chert (Figure 1c).

Tabular Cores

A tabular core resembles a tablet and generally exhibits bidirectional flaking. Three specimens were recovered. Two of these specimens (FFB18.391 and FFB18.415) are stromatolitic chert and the other (FFB18.398) is an algalitic chert. Specimen FFB18.391 is illustrated in Figure 1b.

Multidirectional Cores

A multidirectional core bears flake scars which show that flakes or blades were removed from the core in more than one direction. Only one specimen (FFB18.279) of this type was recovered. It is made of stromatolitic chert (Figure 1d).

Utilized Flakes

Utilized flakes include flakes that have edges suitable for use without modification but exhibit wear in the form of "nibbling" or attrition. Three specimens of this type of tool were recovered from the excavations (Table 5). Specimen FFB18.421 is associated with Component 2, and the other two specimens (FFB18.292 and .293) are associated with Component 3.

Specimen FFB18.292 is a secondary flake with edge wear noted on the ventral surface along the upper medial, right lateral edge and on the dorsal surface along the medial, left lateral edge. The edge modification is in the form of very small, submicroflakes that have been removed from the sharp lateral edges of the flake by use. The type of flaking pattern noted on this artifact indicates that a unidirectional scraping motion over a relatively hard surface caused this type of edge wear.

Specimen FFB18.293 is a chunk of authigenic chert with edge wear noted along part of the base of a large flake scar. This type of edge wear is reminiscent of that associated with the notch or "spokeshave." The sharp edge associated with this modification is slightly worn or ground, which may indicate its use on a soft material such as wood or bone.

Specimen FFB18.421 is a thin, tertiary flake fragment with edge wear noted along the right lateral edge. The edge wear consists of attrition scars occurring bifacially along the edge. This type of wear pattern is indicative of a cutting action. The edge appears to be slightly worn or ground and, because the wear pattern appears to be uniform, a back and forth cutting action is indicated. The small amount

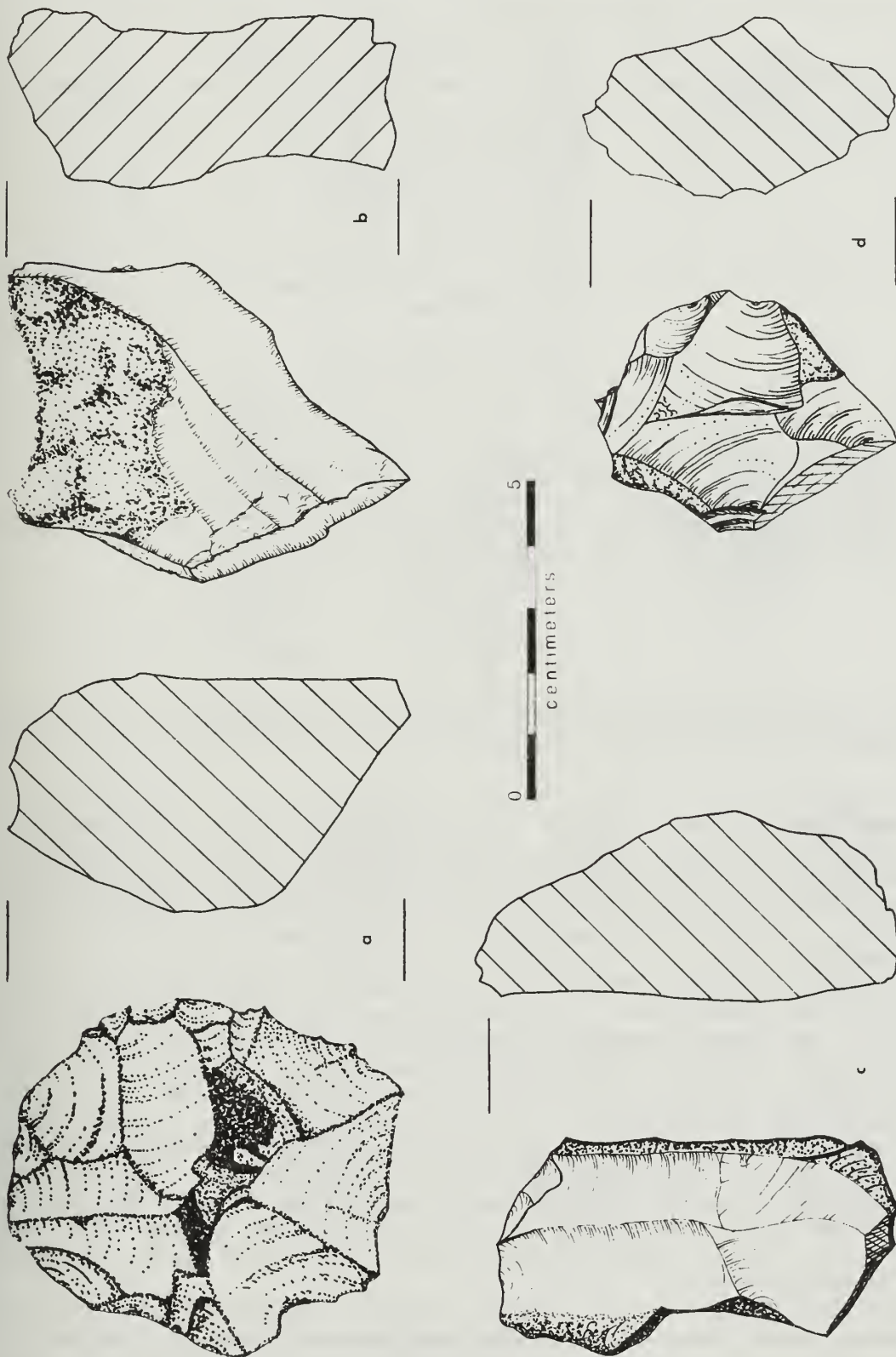


Figure 1. Illustrations of the four types of cores recovered from Component 3 at the Buffalo Hump site: (a) discoidal core, (b) tabular core, (c) bidirectional core, and (d) multidirectional core.

Table 5. Summary of retouched and utilized flakes from Buffalo Hump site.

Component	Flake Stage	Material Type	Dimensions			Location of edge wear	Type of edge wear
			L (mm)	W (mm)	T (mm)		
Retouched Flakes							
2	T	Au	54.1	15.3	3.7	B	N, U
2	S	Do	51.7	27.5	14.8	L	B
3	T	Au	59.1	27.5	14.8	D, L	U
Utilized Flakes							
2	T	Do	24.1	18.5	3.3	L	B
3	S	Bi	26.0	13.5	8.7	L	U
3	C	Bi	39.4	17.5	10.0	L	U

Key: Flake Stage: P = Primary, S = Secondary, T = Tertiary, C = Chunk
Material Type: Au = authigenic chert, Bi = biogenic chert, Do = Dendritic opal
Dimensions (in millimeters): L = Length, W = Width, T = Thickness
Location of edge wear: D = Distal edge, L = one lateral edge, B = both lateral edges
Type of edge wear: N = notch, U = unifacial, B = bifacial

of attrition would seem to indicate that this artifact was used to cut soft material such as meat or hides.

Retouched Flakes

Retouched flakes consist of flakes or pebbles that exhibit intentional flake removal from the edge in order to produce or resharpen an edge that is suitable for use. Three of this type of artifact were recovered from the excavations (Table 5). Two specimens (FFB18.327 and .458) are associated with Component 2, and specimen FFB18.377 is from Component 3.

Specimen FFB18.327 (Figure 2a) is a tertiary blade exhibiting two types of edge modification. The most distinct is a large shallow notch located on the dorsal surface of the blade in the lower medial area of the right lateral edge. This notch, or "spokeshave," exhibits very fine flaking with a slightly ground edge that appears to have been caused by use rather than manufacture. Also noted along the right lateral edge, both proximally and distally from the notch, are microflake scars indicative of use rather than intentional manufacturing. This type of microwear is also noted along the entire medial area of the left lateral edge. These flake scars occur on the dorsal surface of the blade and appear to have been slightly ground by use. The cross section of this blade is planoconvex.

Specimen FFB18.377 is a large, blocky, tertiary flake with a triangular cross section. The edge modification occurs on the dorsal surface at the left, lateral, distal end of the flake. The modification

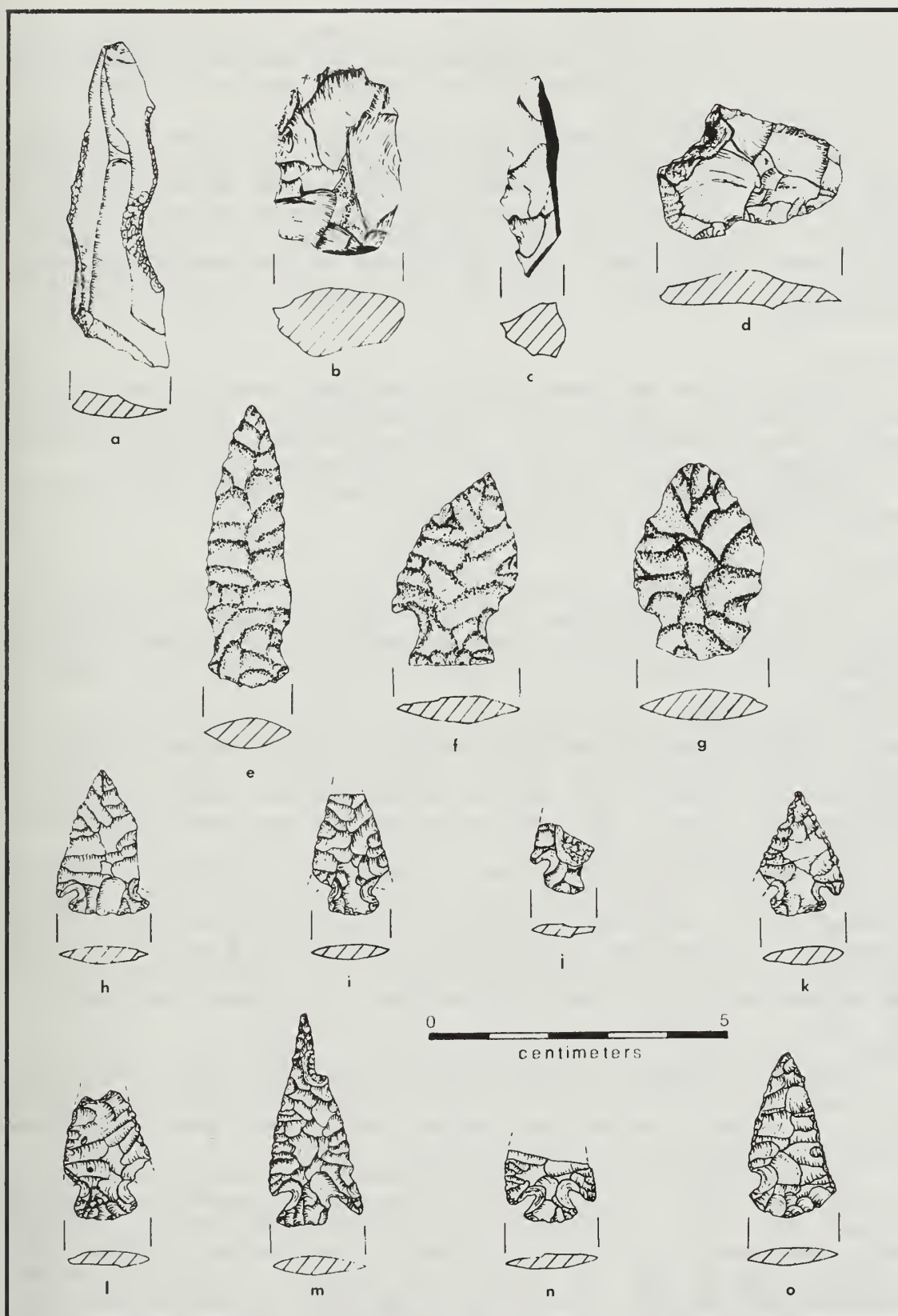


Figure 2. Examples of flaked lithic artifacts from the Buffalo Hump site: retouched flake (a); preblank (b); blank fragment (c); drill fragment (d); hafted bifaces (e-g); Type I (Ruby Corner-notched) projectile point (h); Type II (Rose Spring) projectile points (i-l); Type III (Indeterminate corner-notched) projectile points (m-n); Type IV (Indeterminate) projectile point (o).

includes the removal of micro- and submicroflakes to form a sharp edge. This type of modification may indicate that the edge was resharpened as it was dulled by use, although other natural, unmodified edges exist with no apparent use-wear.

Specimens FFB18.458 and FFB18.102 fit together to form a secondary flake with bifacial edge modification along the left lateral edge. The modification consists of the removal of micro- and submicroflakes in order to form a sharp edge. The edge wear appears to represent platform preparation associated with the preliminary stages of manufacturing a biface from a large flake. The flake appears to have been broken during this stage and discarded. There is no evidence of use-wear noted on this artifact.

Preblank

Preblanks have had flakes (to thin the face) removed bifacially but retain cortex. This type of artifact is very crude. It has no definite form or shape resembling a tool. Only one specimen was recovered from the excavations, and it is associated with Component 2 (Table 6).

Specimen FFB18.97 (Figure 2b) is a small cobble which has had several flakes removed from both surfaces.

Blanks

Blanks have been bifacially thinned to a point where most, if not all, of the cortex has been removed. These artifacts are thick and blocky, and could be fashioned into any number of tool forms. Only one specimen was recovered from the excavations, and it is from Component 2 (Table 6).

Specimen FFB18.474 (Figure 2c) is a lateral edge fragment of a large, thick, bifacially modified artifact. This fragment exhibits a large, crude flaking pattern with no edge retouching. Apparent platform preparation was noted. This artifact appears to have been broken during manufacture. Flaws in the source material may have contributed to the breakage of this specimen.

Specimen FFB18.13 is a base fragment of a bifacially modified artifact. This fragment has been partially thinned through bifacial flaking but is thick and blocky in its center and exhibits no edge retouching. It appears to have been broken during manufacture and discarded. Because it was recovered from a test unit far removed from the excavation block, it cannot be assigned to a cultural component.

Drill

Drills have been bifacially reduced and exhibit a long, thin distal end that has been flaked laterally to produce a nearly circular or thickly biconvex cross section, rather than thinned edges. Only one possible specimen was recovered (Table 6).

Specimen FFB18.281 (Figure 2d) appears to be a base fragment of an expanded stem drill. The distal end is missing and appears to have been snapped off. It is impossible to tell whether the breakage occurred during manufacture or use. The base is rectangular in shape with straight lateral edges and base. The flaking is extremely random. Unifacial edge retouch was noticed on one surface. This artifact does exhibit some thermal alteration in the form of shattering along the distal edge of the base, but it is difficult to determine if this happened before or after the artifact was discarded. The cross section

Table 6. Summary of lithic tools recovered from Buffalo Hump site.

Artifact Type	Cat. # (FFB18.)	Grid Location	Type	Material Type	L	W	T	Dimensions BW	NW	SL	Base	Blade Shape	Cross Section	Component
Bifaces														
Preblank	97	123N/ 332 E NW $\frac{1}{4}$	Pre- blank	Au	30.8	20.7	10.7	-	-	-	-	Ovate	Biconvex	2
Blank	474	115.92N/ 321.12 E	Blank	Al	-	-	-	-	-	-	-	-	Biconvex	2
Blank	13	114.95N/	Blank	Al	31.3	27.0	5.4	-	-	-	Convex	Ovate	Biconvex	-
Drill	281	117.8N/ 320.8 E	Expanded Stem	Au	-	-	-	22.5	-	16.7	Concave	-	Biconvex	2
Hafted biface	142	125.92N/ 321.4 E	Side- notched	Al	46.2	14	5.4	13.3	11	6.6	Convex	Lanceolate	Biconvex	3
Hafted biface	173	123N/ 318 E NW $\frac{1}{4}$	Side- notched	Oq	32	18.5	4.4	15	12	8.7	Straight	Triangular	Biconvex	3
Hafted biface	188	123N/ 318.61 E	Side- notched	Oc	32.7	21.5	6	16	14.6	6	Convex	Acuminate	Biconvex	3
Projectile Points														
Ruby Corner- notched	248	126.12N/ 307.67 E	I	Au	24.1	15.1	2.8	13.5	10	3.8	Convex	Triangular	Biconvex	3
Rose Spring	71	126.01N/ 335.47 E	II	Al	20.4	12.8	2.8	8.7	7	4.1	Convex	Triangular	Biconvex	3
Rose Spring	178	125N/ 326 E SW $\frac{1}{4}$	II	Al	-	-	1.9	7.2	5.5	4.2	Convex	-	Biconvex	3
Rose Spring	220	121.35N/ 329.64 E	II	Al	20.6	14.5	2.8	9.2	7	3.9	Convex	Triangular	Biconvex	2
Rose Spring	437	123N/ 314 E SW $\frac{1}{4}$	II	Al	-	14.2	2.4	10	7.5	5.3	Convex	Triangular	Biconvex	2

Table 6. Concluded.

Type of Artifact	Cat. #	Grid Location	Type	Material Type	L	W	Dimensions T BW	NW	SL	Base	Blade Shape	Cross Section	Component
Projectile Points (Continued)													
Indeterminate corner-notched	335	115N/ 318 E SW $\frac{1}{4}$	III	Ch	35.1	14.1	3.2 11.6	6.4	4.2	Straight	Triangular	Biconvex	3
Indeterminate corner-notched	444	117N/ 308 E SW $\frac{1}{4}$	III	Al	-	11.9	2.8 8.9	5.4	4.8	Convex	Triangular	Biconvex	2
Indeterminate	2	121.49N/ 341.81 E	IV	Ch	27.5	14.2	2.5 -	-	-	-	Triangular	Biconvex	2
Indeterminate fragment	261	117N/ 326 E NW $\frac{1}{4}$	IV	Oc	-	-	- 17.3	13.3	7.9	Convex	-	Biconvex	2
Indeterminate fragment	372	117N/ 312 E NE $\frac{1}{4}$	IV	Al	-	-	- -	-	-	Convex	-	Biconvex	2

Key: Material Type: Au = Authigenic chert, Al = Algalitic chert, Ch = Chalcedony, Oc = Ortho-quartzite, Oc = Oolitic chert
Dimensions (in millimeters): L = Length, W = Width, T = Thickness, BW = Base width, NW = Neck width, SL = Stem length

of the base is planoconvex, and the distal portion appears to have been biconvex. This artifact was recovered from Component 2.

Hafted Bifaces

Hafted bifaces display the characteristics of a final biface or completed tool form with a hafting element, such as a notch and/or a stem. These tools have been distinguished from projectile points primarily because of the pronounced use-wear on their edges. A total of three of this type of artifact was collected from the excavations. All are from Component 3 (Table 6).

Specimen FFB18.142 (Figure 2e) has a long, slender, triangular blade shape. One lateral edge is convex while the other is slightly concave. The concave lateral edge may be the result of resharpening. This artifact is side-notched, and the notches are placed very low on the blade. These notches are very shallow, and the shape is rounded. The stem is expanding with a convex base. Some basal thinning was also noted. The flake pattern is random with fine edge retouching. No grinding was noted but, as was mentioned before, one edge appears to have been resharpened. The cross section is biconvex.

Specimen FFB18.173 (Figure 2f) has a thin, broad, triangular-shaped blade with convex lateral edges. This artifact is side-notched with large, rounded notches. The stem is expanding with sharp lateral corners and a straight base. The stem is placed at an oblique angle to the blade. The flaking pattern is random without any evidence of edge retouching, although the oblique shape of this artifact may have been caused by resharpening. The cross section is biconvex.

Specimen FFB 18.188 (Figure 2g) has a broad, thick, triangular blade shape with convex lateral edges and a blunted tip. No edge retouching is evident, and this artifact does not exhibit the attributes caused by resharpening. The notches were crudely manufactured and occur perpendicular to the lateral edges. These notches are rounded and shallow. The stem is only slightly expanded with a convex base. No basal thinning or grinding of any of the edges was noted. The flaking pattern is random with edge angles steeper on the dorsal side of the blade. The cross section is biconvex.

Projectile Points

A total of ten projectile points was collected from the excavations (Table 6). These specimens were separated into four types according to morphological attributes. These types were then compared to known types, in order to derive two type names. The third and fourth types could not be associated accurately to any named types. The types discussed below represent two cultural components with mean radiocarbon ages of 1406 years (Component 2) and 1202 years (Component 3), which place both components in the Late Prehistoric period.

Type I: Ruby Corner-notched

Specimen FFB18.248 has a triangular blade shape with convex lateral edges (Figure 2h). The notches are narrow and deep and extend from the corners toward the lower medial portion of the blade. The stem is expanding to the point that its width is only slightly smaller than the blade. The base is convex and has been thinned. The flaking is essentially collateral, although the medial ridge usually associated with this type of flaking pattern is not pronounced in this specimen.

Very little edge retouch was noted, and none of the edges are ground. The cross section is biconvex.

This type of projectile point is similar to projectile points recovered from the LoDaisKa site (Irwin and Irwin 1959) and the Magic Mountain sites (Irwin-Williams and Irwin 1966) located in the foothills of the front range in Colorado. This type was designated as the Ruby Corner-notched point and appears to belong to the Early Ceramic period or the Plains-Woodland culture. Both of these cultural periods are contemporaneous with each other and with Component 3 at the Buffalo Hump site.

Cultural association: Component 3

Type II: Rose Spring

The four specimens (FFB18.71, 178, 220, 437) representing a Type II point have triangular blade shapes with straight to slightly convex lateral edges and very fine edge retouching (Figure 2i-1). The tangs are slightly rounded. The notches are wider than Type I and extend from the proximal corner of the blade toward the lower medial portion of the blade. The stem is slightly expanding with rounded lateral corners and a straight to convex base. The flaking pattern is random, and none of the edges are ground. The cross sections are biconvex.

This type of projectile point is similar to the Rose Spring Corner-notched type that is associated with the Late Prehistoric period and is found throughout the Great Basin (Holmer 1986) and southwestern Wyoming (Smith 1987c).

Cultural associations: Component 2 (FFB18.220,437) and Component 3 (FFB18.71,178).

Type III: Indeterminate Corner-notched

The two specimens (FFB18.335,444) representing Type II have long narrow triangular blade shapes with convex lateral edges exhibiting very fine retouching (Figure 2m, n). The tangs are pointed with deep, moderately wide corner-notches. The stems are triangular in shape with straight to convex bases. The lateral corners of the stems are pointed. Specimen FFB18.444 exhibits basal thinning. The flaking pattern is random but exhibits very fine workmanship. The cross sections are biconvex.

Cultural associations: Component 2 (FFB18.444) and Component 3 (FFB18.335)

Type IV: Indeterminate

The two base fragments (FFB18.261,372) appear to represent large corner-notched artifacts, possibly hafted bifaces. These fragments are too small to determine morphological or technological attributes. The third specimen (FFB18.2) appears to have been reworked into its present form (Figure 2o). The blade shape is triangular with slightly convex lateral edges. The original base was snapped off at the upper portion of the neck. The base was then slightly thinned, although evidence of the original notches still exists. One lateral edge has been notched perpendicular to the edge. The notch is wide and rounded. The flaking pattern is random with very fine edge retouching. No edge grinding was

noted, although this artifact in its present form may have served as a knife.

Cultural association: Component 2

Groundstone Artifacts

A total of 38 fragments of groundstone was recovered from the excavations and an additional 3 specimens were found in the Frontier pipeline right-of-way (Table 7). With the exception of the 3 specimens from disturbed contexts, all of the groundstone was collected from Component 2 (27 specimens) and Component 3 (11 specimens). No complete groundstone artifacts were recovered although some of the fragments fit together to form larger fragments. Component 2 yielded 23 fragments of ground, tabular sandstone slabs, 3 fragments of ground and pecked, tabular sandstone slabs, and 1 shaped mano of quartzite. The mano was shaped by pecking or pounding the sides to form an oval shape. No grinding was noted on the sides or edges of this artifact. In Component 3, eight of the specimens are fragments of ground, tabular sandstone slabs, and the three other specimens fit together to form a fragment of a shaped sandstone mano. This mano fragment was shaped into a oval loaf form by pecking and grinding the edges.

One other groundstone artifact (FFB18.133) was recovered from Component 3. This specimen (Figure 3) is a very thin piece of tabular sandstone. The edges have been ground to form a rectangular shape, and the cross section is concavo-convex. The convex surface has been ground smooth while the concave surface shows no evidence of grinding or any other type of alteration. The convex ground surface exhibits minute striations which traverse the width of the specimen. This artifact may represent the preliminary stages of manufacture for an ornament or nonutilitarian item such as a pendant or gaming piece.

Twenty-seven (71%) of the groundstone artifacts show evidence of thermal alteration. All the thermally altered specimens are fragments of tabular sandstone slabs. Most of these fragments were probably burned after the grinding slabs broke and were discarded. However, some may have been used as heat conductors for various types of plant processing or food preparation and were broken as a result of their use in conjunction with heat.

Modified Bone

This section provides a detailed description of 22 culturally modified bone specimens from the Buffalo Hump site. Table 8 briefly describes each specimen. Table 9 more clearly presents the cultural component association for each specimen. Four descriptive categories are presented: awl, tube, tube discard, and miscellaneous. All specimens are assigned to one of these categories. In addition, all specimens were examined microscopically (20x) for evidence of striation/abrasion marks and polish or use-wear. Two terms are used to describe location on several specimens. "Tip" and "base" refer to the working and the nonworking ends, respectively, on specimens such as awls. The term "wear" refers to the smooth, polished appearance occurring on tools due to use and on decorative items due to actual wear. To conclude this

Table 7. Summary of relevant data on groundstone artifacts from the Buffalo Hump site.

Type and condition	Catalog # (FFB18.)	Grid Location	Maximum Dimensions (cm)		Weight (grams)	Thermally Altered	Feature Associations	Component
			Length	Width				
Shaped mano fragment	78	124.96N/322.85E	5.5	4.4	2.8	71.7	No	Near Feature 8
Slab fragment	92	123.35N/322.20E	8.6	4.8	2.1	111.2	No	Near Feature 16
Slab fragment	131	126.43N/321.55E	8.2	5.1	2.0	107.1	No	Near Features 6 and 8
Slab fragment	132	125N/320E SE $\frac{1}{4}$	2.9	2.1	1.3	9.0	Yes	Near Feature 8
Indeterminate-complete	133	125N/320E NE $\frac{1}{4}$	4.9	3.5	0.3	9.7	No	Near Feature 8
Shaped mano fragment	165	125.70N/323.70E	4.8	3.9	1.9	62.1	No	Near Feature 8
Slab fragment	166	126.50N/322.35E	5.8	3.9	1.6	52.0	Yes	Near Features 6 and 8
Shaped mano fragment	185	123N/318E NW $\frac{1}{4}$	6.6	5.5	2.7	89.3	No	Near Feature 8
Slab fragment	207	120.64N/323.01E	5.8	5.0	1.1	41.4	Yes	Near Feature 16
Slab fragment	208	120.77N/322.80E	7.6	5.6	1.6	102.3	Yes	Near Feature 16
Slab fragment	209	120.48N/323.18E	11.8	10.7	1.9	306.9	Yes	Near Feature 16
Slab fragment	211	119N/320E SE $\frac{1}{4}$	3.2	2.0	1.3	9.5	Yes	Near Feature 16
Slab fragment	212	120.15N/321.52E	9.1	5.6	1.8	143.8	Yes	Near Feature 16
Slab fragment	241	125.59N/320.80E	9.2	5.8	1.8	138.5	Yes	Near Feature 16
Slab fragment	284	117N/322E NE	6.0	2.9	1.4	30.1	No	In Feature 8
Slab fragment	298	119.55N/323.28E	11.9	10.0	1.7	229.5	Yes	Near Feature 16
Slab fragment	299	119.85N/323.55E	9.2	6.3	1.6	138.6	Yes	In Feature 16
Slab fragment	300	119.20N/322.00E	8.6	6.1	2.1	190.7	Yes	In Feature 16
Slab fragment	314	119.28N/329.70E	11.9	8.5	4.8	694.6	Yes	In Feature 11
Slab fragment	329	118.68N/319.41E	6.8	4.4	1.6	56.2	Yes	Near Feature 16
Slab fragment	339	119N/332E NW $\frac{1}{4}$	3.1	3.1	1.6	20.0	Yes	In Feature 16
Slab fragment *	340	119.80N/322.50E	10.1	7.9	2.3	251.5	Yes	In Feature 16
Slab fragment	341	120.27N/323.20E	8.7	4.9	2.0	114.5	Yes	In Feature 16
Slab fragment	342	119.60N/322.50E	11.8	5.8	2.2	182.6	Yes	In Feature 16
Slab fragment	343	119.85N/323.30E	9.9	6.0	2.4	219.7	Yes	In Feature 16
Slab fragment	345	119N/322E SW $\frac{1}{4}$	4.7	3.8	2.2	48.9	Yes	In Feature 24
Slab fragment	346	119N/322E SW $\frac{1}{4}$	11.4	8.2	2.4	301.3	Yes	In Feature 24
Slab fragment	357	115N/322E NE $\frac{1}{4}$	5.5	3.7	1.4	36.1	No	Near Feature 16
Shaped mano fragment **	368	117.20N/312.34E	6.7	5.6	2.5	132.6	No	Near Feature 16
Slab fragment	370	117.50N/312.52E	10.1	6.4	1.8	105.6	No	Near Feature 34
Slab fragment	375	118.33N/312.52E	7.6	7.3	2.2	158.5	Yes	Near Feature 34
Slab fragment	388	125.10N/314.67E	4.0	2.4	1.2	15.2	Yes	Near Features 28, 29, 30
Slab fragment	399	120.51N/312.75E	13.4	7.5	1.8	206.1	Yes	Near Feature 16
Slab fragment	409	122.96N/308.80E	7.0	5.5	1.3	50.4	Yes	
Slab fragment	410	122.70N/309.49E	5.6	3.9	7.3	22.7	No	
Slab fragment	431	Disturbed surface	5.2	4.9	1.4	49.6	Yes	
Slab fragment	460	115N/322E NE $\frac{1}{4}$	4.4	2.5	1.8	17.4	Yes	Near Feature 16
Slab fragment	470	117.38N/324.78E	4.6	3.8	1.4	26.8	No	Near Feature 16

Table 7. Concluded.

Type and condition	Catalog # (FFB18.)	Grid Location	Maximum Length	Dimensions (cm) Width Thickness	Weight (grams)	Thermally Altered	Feature Associations	Component
Slab fragment	486	118.00N/314.00E	11.8	4.4	2.2	164.8	No	2
Slab fragment	491	Disturbed surface	9.0	6.0	1.9	106.6	Yes	-
Shaped mano-complete	492	Disturbed surface	1.5	8.3	4.7	975.7	No	-

* Pollen wash (ASS #885) analyzed

** Made of orthoquartzite; all others are sandstone

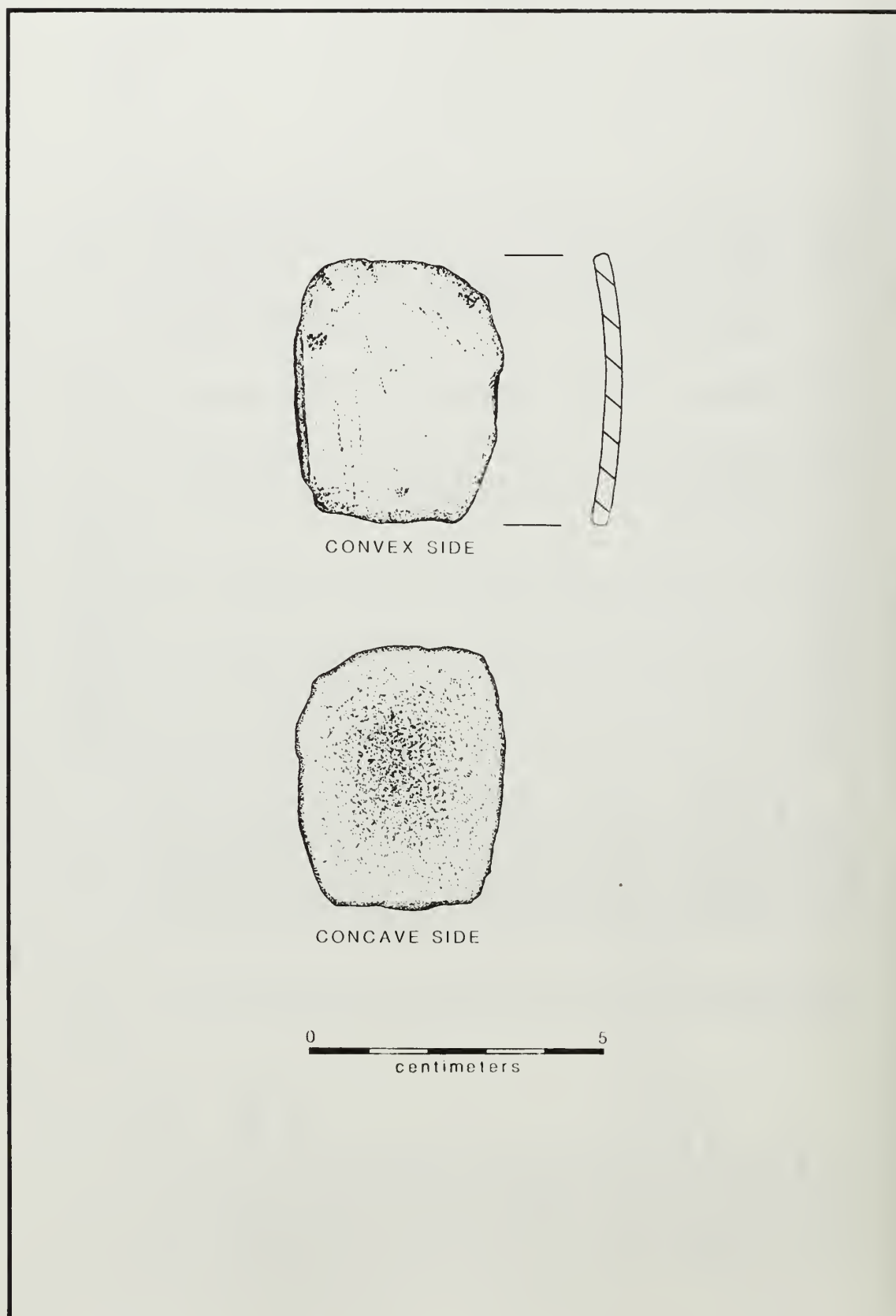


Figure 3. Illustration of the indeterminate groundstone artifact recovered from Component 3 at the Buffalo Hump site.

Table 8. Description of culturally modified bone specimens at the Buffalo Hump site.

Specimen Type	Taxon	Element	Portion	Modification Locale*	Preservation	Condition	Length (mm)	Weight (g)	Provenience	Component**	Catalog Number AS-WWC
Aw1	pronghorn	meta-tarsal	anterior shaft	one end	good	complete	85	5.6	125.27N/ 312.22E SW L-2	3	FFB18.289
Aw1	pronghorn	meta-tarsal	proximal anterior shaft	shaft end	good	complete	87	6.8	119N/314E SW L-7	2	FFB18.366
Aw1	medium to large mammal	long bone	shaft	shaft end	poor	complete	73	2.3	119N/322E NW L-7	2	FFB18.194
Aw1	<u>Lepus</u> sp.	tibia-L	shaft	proximal shaft end	fair	complete	99	3.3	119N/328E SE L-7	2	FFB18.224
Tube	<u>Lepus</u> sp.	humerus-R	distal shaft	both ends	good	complete	40	1.2	121N/310E NW L-2	3	FFB18.385
Tube	<u>Lepus</u> sp.	tibia	distal shaft	both ends	good	fragmentary	27	0.5	123N/312E N½ Fea. 29	3	FFB18.502
Tube	<u>Lepus</u> sp.	meta-tarsal	shaft	both ends	good	fragmentary	17	0.2	123N/312E N½ Fea. 29	3	FFB18.503
Tube	<u>Lepus</u> sp.	meta-podial	shaft	both ends	good	complete	34	0.5	117.38N/ 312.54E SW L-4	2	FFB18.376
Tube	small mammal	long bone	shaft	both ends	fair	fragmentary	17	0.2	121N/328E Fea.1 L-6	2	FFB18.494
Tube	small mammal	long bone	shaft	both ends	good	complete	22	0.2	119N/328E SE L-7	2	FFB18.227
Tube	small mammal	long bone	shaft	both ends	good	fragmentary	16	0.1	119N/328E SE L-7	2	FFB18.227b

Table 8. Concluded.

Specimen Type	Taxon	Element	Portion	Modification Locale*	Preservation	Condition	Length (mm)	Weight (g)	Provenience	Component**	Catalog Number AS-WWC
Tube	small mammal	long bone	shaft	one end	good	fragmentary	14	0.2	123N/312E S½ Fea. 29	3	FFB18.347
Tube discard	<u>Lepus</u> sp.	femur-L	distal	shaft end	fair	complete	51	2.5	119N/330E SE L-5	2	FFB18.498
Tube discard	<u>Lepus</u> sp.	tibia-L	proximal shaft	mid-shaft end	fair	complete	58	1.9	123.33N/ 331.30E SE L-7	2	FFB18.154
Tube discard	<u>Lepus</u> sp.	tibia-R	proximal shaft	mid-shaft end	fair	complete	46	1.7	123N/334E NW L-3	2	FFB18.496
Tube discard	<u>Lepus</u> sp.	tibia-R	proximal shaft	mid-shaft end	fair	complete	47	2.1	119.03N/ 323.56E SE L-9	2	FFB18.499
Tube discard	<u>Lepus</u> sp.	tibia-R	distal	shaft end	fair	complete	20	0.8	123N/330E SW L-8	2	FFB18.272
Tube discard	<u>Lepus</u> sp.	tibia-R	distal	shaft end	good	complete	22	1.1	119N/328E SW L-7	2	FFB18.500
Tube discard	<u>Lepus</u> sp.	meta-tarsal	proximal	shaft end	good	complete	14	0.3	123N/334E NW L-1	2	FFB18.495
Tube discard	<u>Lepus</u> sp.	meta-tarsal	proximal	shaft end	good	complete	15	0.2	123N/332E SE L-4	2	FFB18.497
Miscellaneous	large mammal	flat bone	body	entirety	good	complete	13	0.1	125N/318E NE L-5	3	FFB18.318
Miscellaneous	medium to large mammal	rib	body	lateral margin	fair	fragmentary	14	0.2	123N/316E SE L-4	3	FFB18.501

* see discussion for additional specimen modifications

** see Table 9

Key: R = right, L = left

Table 9. Bone specimen types within cultural components at the Buffalo Hump site.

Component 2 1480 ± 60 years B.P.	Component 3 1250 ± 60 years B.P.	Catalog Number AS-WWC
	Aw1	FFB18.289
	Tube	FFB18.385
	Tube	FFB18.347
	Tube	FFB18.502
	Tube	FFB18.503
	Miscellaneous	FFB18.318
	Miscellaneous	FFB18.501
Aw1		FFB18.366
Aw1		FFB18.194
Aw1		FFB18.224
Tube		FFB18.376
Tube		FFB18.494
Tube		FFB18.227a
Tube		FFB18.227b
Tube discard		FFB18.154
Tube discard		FFB18.496
Tube discard		FFB18.499
Tube discard		FFB18.272
Tube discard		FFB18.500
Tube discard		FFB18.495
Tube discard		FFB18.497
Tube discard		FFB18.498

ection, several comparisons to similar sites will be offered as well as possible functions for the various specimens.

Bone Awls

Four specimens of bone awls, all of which share certain characteristics yet exhibit distinct differences, were recovered. The first two specimens exhibit a high polish along a working surface which tapers gradually to a pointed tip.

Specimen FFB18.289 (Figure 4a), a metatarsal shaft fragment from a large mammal, begins tapering and is highly polished ca. 35 mm from the tip (41% of the entire length). Near the tip, the cross section appears slightly oval. The base of the tapered section is oval in cross section and is ca. 20 mm in circumference. Microscopic examination of this polished area reveals numerous diagonal and a few transverse striations along the entire surface. The opposite end of this specimen exhibits a characteristic spiral fracture break and appears not to have been modified further. It is possible that this end has been broken since the time of the tool's initial production. A portion of the anterior vascular groove is still present on this specimen.

Specimen FFB18.366 (Figure 4b), a metatarsal shaft fragment from a large mammal, begins tapering and is highly polished ca. 45 mm from the tip (51% of the entire length). The cross section of this specimen appears round near the tip and gradually becomes oval near the base of the taper. The circumference at the base of the taper is ca. 30 mm in diameter. Microscopic examination reveals similar striation patterns as are present on Specimen FFB18.289. Additionally, the lateral edges of the proximal half of this specimen are slightly polished. The proximal end of this specimen retains a portion of one of the two larger

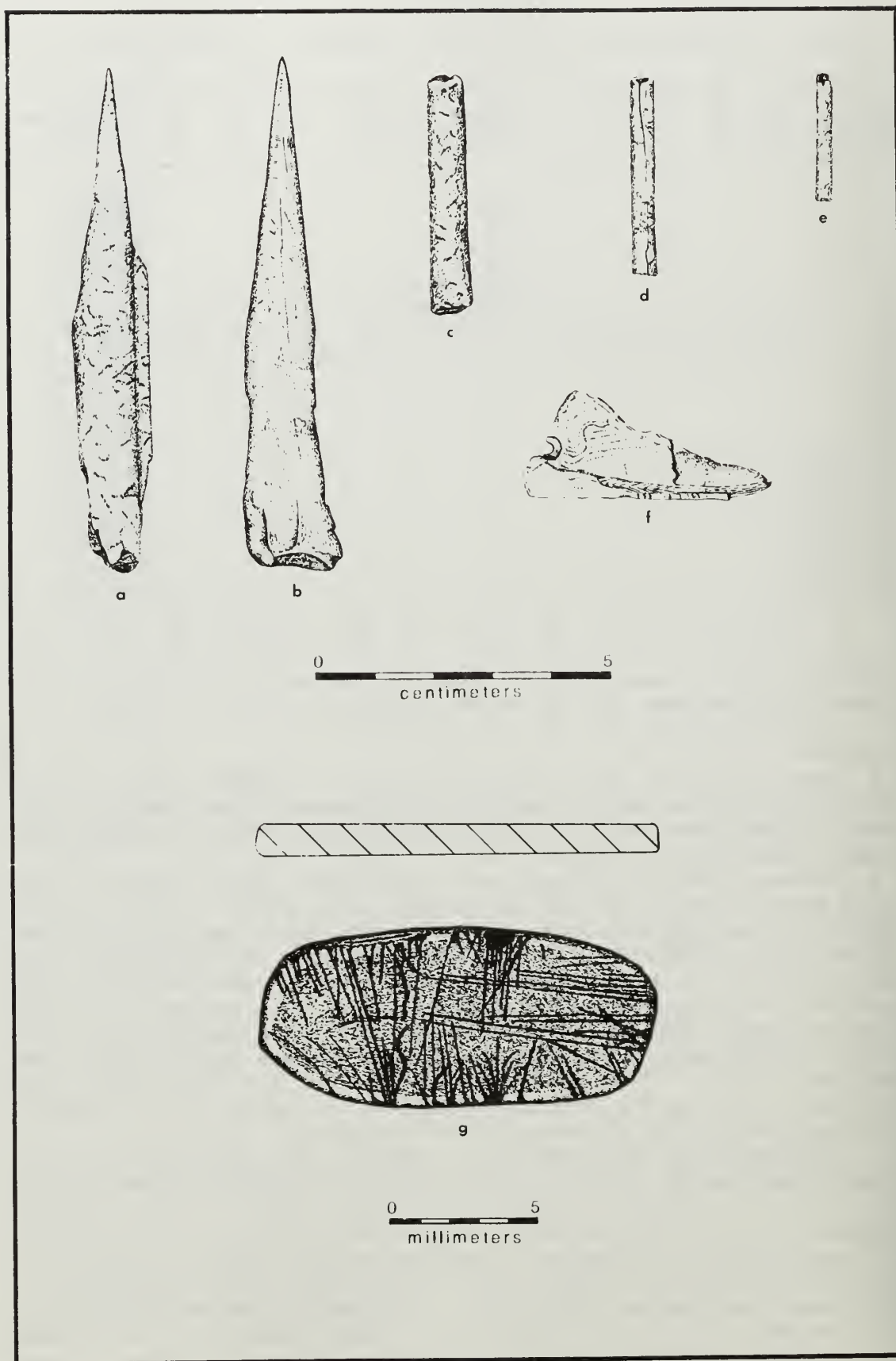


Figure 4. Examples of modified bone and shell artifacts from the Buffalo Hump site: bone awls (a, b); bone tubes (c-e); drilled mussel shell (f); and miscellaneous object (g).

articular surfaces of the metatarsal. Other modifications on this specimen include two isolated areas where the bone is blackened, possibly the result of burning or charcoal staining.

The third specimen, FFB18.194, is in such poor condition that only a clue as to its elemental origin or location is possible. Initially it was believed to have been fashioned from a long bone in such a way as to retain a basal end from at or near either the end of a proximal long bone such as a metapodial, or an epiphyseal margin from any immature long bone. Further examination suggests an alternative explanation. Without question the specimen represents a long bone shaft fragment, but the nonworking end appears modified. Possibly this area was entirely incised and/or snapped off in such a way as to produce an even edge almost perpendicular to the long axis of the bone. Although no definite groove or incision mark is discernible, the lack of fine cancellous tissue (which is usually present within the ends of long bones) tends to favor this alternative possibility. Unfortunately, the condition of this specimen prevents any definite origin conclusion.

The most striking aspect of Specimen FFB18.194 is its short, slender, delicate tip. This tip is ca. 9 mm long and tapers very little. The circumference near the tip is ca. 4 mm while ca. 9 mm from the tip the circumference is 6 mm. Very few traces of polishing can be detected on the surface within this area, and microscopic examination revealed no definite presence of striation patterns. Abruptly from the tip base the bone wall expands to ca. 6 mm wide and continues at this dimension until it widens again to ca. 16 mm near the basal end. Possibly a longitudinal portion of this specimen has broken off, thus leaving this unusually delicate tip. Once again, the poor condition of this specimen prevents any definite conclusion.

The last specimen in this category, FFB18.224, is fashioned from the left tibia of a jackrabbit (probably Lepus townsendii). The tip (i.e., the proximal shaft end) is blade-like and extends for ca. 13 mm from the pointed tip. Two edges of the shaft, which meet to form the tip, are slightly polished along this length. Microscopic examination along these polished areas reveals a few longitudinal and even fewer transverse striations. Both ends exhibit characteristic spiral fracture breaks. A slight polish along the shaft is the only other observed modification.

Bone Tubes

Eight specimens are assigned to the bone tubes category based upon general element type, manufacturing technique, and final product. All specimens are from jackrabbit (or animal of similar size) long bones, display incised or worn ends, and exhibit a slight to high surface polish. In the following descriptions, the term "incomplete incision" refers to the remains of an incision or groove which does not completely encircle the bone shaft.

Specimen FFB18.385 (Figure 4c), a right humerus shaft fragment, appears to have been incompletely incised at both ends. As a result, the snap of the proximal and distal ends produced isolated, jagged edges. Although these edges have been smoothed and polished, they still retain an uneven appearance. Microscopic examination does reveal very minute longitudinal striations along the margins of both ends, but polish or wear appears to have obscured many of these marks. Wear or polish is evident on both the outside and the inside edges on both ends.

The body of this specimen exhibits a high polish along most of its surface.

Specimen FFB 18.502, a tibia shaft fragment, has been burned almost to the stage of complete calcination. This specimen was recovered in six fragments within a feature (Feature 29). As a result, the original bone surface has been slightly altered. A slight polish is evident along isolated portions of the specimen surface. Both ends show signs of either partial or complete incision. Striation marks are evident within and parallel to the groove remnants on both ends and are probably the result of the incision process. Wear appears slight to nonexistent on both ends, which leads to the assumption that this specimen may have been fractured or broken during production and thus discarded.

Specimen FFB18.503, a metatarsal shaft fragment, is similar in general appearance to FFB18.502 in that it has been burned; also, original surface characteristics have been altered as a result of this process. One end of this specimen shows slight polish or wear. No definite incision mark remains on this end, suggesting that either no grooving or only slight grooving was necessary. The opposite end retains only a portion of the original manufactured margin (due to a recent break), but suggests a condition similar to the other end. Slight traces of polish can be detected along the surface.

Specimen FFB18.376 (Figure 4d), a metapodial shaft fragment, is similar in general appearance to FFB18.385 although the snap breaks have produced much more even edges on both ends. The distal shaft end has been work internally so as to produce a sharp, bevelled edge around its entire circumference. Very little wear is evident on the outer edge on this end. The opposite end is worn smooth and polished, as is the entire shaft surface; thus, only slight traces of minute striations are present.

Specimen FFB18.494, a long bone shaft fragment (metapodial), has been damaged recently in such a way that both ends retain only a portion of the original incised margin. The poor condition of this specimen may be associated with this damage, as is the lack of surface polish on the deteriorating shaft. Whether or not the incised grooves completely encircle the shaft can not be determined.

Specimen FFB18.227a (Figure 4e), a long bone shaft fragment, shows evidence of a complete, or nearly complete, incision on both ends producing an even edge on one end and an uneven edge on the other end. Both ends and the shaft surface are polished.

Specimen FFB18.227b, a long bone shaft fragment, is an incomplete tube which has been subjected to heat. One end has been bevelled and smoothed producing a 30° surface angle. Microscopic examination of this ends reveals several minute transverse striations, which suggests an intentionally formed edge. The opposite end exhibits an even transverse edge. Both ends and the shaft surface are almost completely smooth and polished.

The last specimen of this type, FFB28.347, is an incomplete long bone shaft fragment (possibly a jackrabbit femur). Only one modified end remains, the other having been broken off recently. The incised end shows numerous circumscribed striations resulting from the grooving process. This specimen has also been subjected to heat.

Tube Discards

Eight specimens are assigned to the tube discards category. These specimens share two characteristics. First, they display signs of partial or complete incising on one end while the opposite end retains the articular surface of the bone element or has been broken near the articular end. Second, none of the specimens exhibit surface polishing. For these two reasons these specimens are believed to be the discards, or unused bone fragments, resulting from bone tube production.

The first three specimens (FFB18.154, FFB18.496, and FFB18.499) are jackrabbit tibia. An incised groove completely encircles the end of FFB18.499. The remaining two specimens display uneven edges produced during the snap break. These incised ends represent the distal shaft portion of the tibia. On all three specimens, these incisions are from 13 mm to 17 mm distal to the point at which the fibula fuses to the tibia. The opposite ends on all three specimens display characteristic spiral fracture breaks and are located not more than 25 mm from the proximal end of the tibia. Although there appears to be a potential for additional bone tubes from these specimens, no further modifications are apparent. They presently exhibit longitudinal shaft cracks, but it cannot be determined whether these cracks developed during the manufacturing process and thus resulted in the bone being discarded or if the cracks developed some time after discarding.

Specimens FFB18.272 and FFB18.500, of jackrabbit distal tibia, are similar in size and shape, but FFB18.272 is partially burned and exhibits the remains of a complete incision. Specimen FFB18.500 shows no signs of having been burned and exhibits the remains of an incomplete incision.

Specimen FFB18.495 and FFB18.497, representing jackrabbit proximal metatarsals, differ slightly in appearance. Specimen FFB18.495 exhibits more extreme weathering characteristics; i.e., longitudinal shaft splintering and a white surface color. Both specimens exhibit incomplete incisions and uneven edges. Specimen FFB18.498, a jackrabbit distal femur, exhibits an incomplete incision and an uneven edge also.

Miscellaneous

Two specimens are assigned to the miscellaneous category. Specimen FFB18.318 (Figure 4g), fashioned from a small section of compact bone, is oval in shape and is 12 mm long, 6 mm wide, and 1 mm thick. Both sides and all edges are highly polished. Numerous transverse striations are present on one surface. These striations extend across the surface and appear to be concentrated along one edge. Faint longitudinal striations on both sides appear to be the result of abrasion and/or polishing activity.

Specimen FFB18.501, possibly a rib body fragment from a medium to large mammal, may be only a fragment of butchered bone. There are two unusual cut marks along one margin and evidence of a possible third mark near a broken end. These cut marks appear fairly uniform. They are oriented parallel to each other, they penetrate the bone about the same depth, and they are evenly spaced from each other (ca. 2 mm). Besides being almost completely calcined, this specimen exhibits no additional cultural modifications and offers no clue as to its origin, purpose, or function.

Discussion of Modified Bone Artifacts

Two problems commonly encountered during the descriptive phase of culturally modified objects are (1) what to call the objects and (2) functional implications in names. A specimen recovered from one site may be identified differently should a similar specimen be found at another site due to the finder's personal opinion or past experience. The mere mention of a particular term (object name) creates a mental picture, which at times differs from one individual to another. At first glance these problems may appear to be significant problems, but actually they are valuable analytical tools for archaeologists. They prevent sites which differ spatially, temporally, and culturally from being lumped together or considered similar on the basis of similar objects. They ensure that sites which are believed to be similar actually are similar or contemporary. They enable one to examine certain specimens and note continuity existing between sites which differ chronologically, geographically, and culturally. Ideally, arguments arising from these problems lead to closer examination and evaluation procedures for the site-specific cultural material.

The terms used to describe the modified bone specimens from the Buffalo Hump site require additional explanation. Two of these specimen types (awls and tube discards) present little difficulty as to their terminology and function. Awls occur commonly in habitation sites throughout the Plains and Western United States. They are usually associated with domestic fabrication activities, such as sewing, hide perforation, or basketry (Driver and Massey 1957:334; Falk 1983:14.4; Harrington 1933:137), serving as perforators, needles, or shuttles. The awls from 48SW5057 are small and delicate, which may imply use on objects of similar size and nature, such as hides of pronghorn or smaller animals or tightly woven baskets. Slight to high polish on three of these specimens further suggests their use on hides or fiber.

Tube specimens are as equally represented at Buffalo Hump as are tube discards. Specimens of this type probably represent either finished ornamental bone beads (Falk 1983:14.10; Frison 1971:275-276; Lucius 1980:97; Walker 1984) or bone bead preforms (Walker 1984) which would be further segmented at a later date. Numerous references have been made suggesting the technique involved in bone tube manufacturing (Dalley 1972:135; Frison 1967:20; 1970:24-26; Frison, Wilson, and Walker 1978:27; Walker 1981:8; 1982:272). A third possibility is that these specimens represent hand game items. The range of variation for specimens of this type has been ethnographically documented for numerous North American Indian tribes (Culin 1907:267-327). The consensus seems to favor the interpretation of these specimens as bone beads or bead preforms.

The miscellaneous specimen (FFB18.318) may remain a mystery object due to its shape and small size. Ethnographic accounts have been gathered from numerous North American Indian tribes describing and illustrating the objects used in dice and guessing games (Culin 1907:44-266). Gaming pieces are described and illustrated from the northwestern Navajo Mountain area in Utah (Lindsay et al. 1968:114, 182-183) and from southwestern Colorado (Gross and Howes 1986:95) which resemble the specimen from Buffalo Hump in terms of size and shape. An alternative possibility for this specimen is that it represents an unfinished button or pendant, lacking one or more perforations from which to attach or hang a string. Whatever its function, this specimen is uniquely shaped,

marked, and polished. The second miscellaneous specimen (FFB18.501) is too fragmentary to yield clues to its function.

Prior to the excavation program conducted at the Buffalo Hump site during the fall of 1985 and the spring of 1986 by AS-WWC, a limited data recovery program was initiated by Powers Elevation Company during the fall of 1983 following their trench monitor (Brechtel et al. 1984:135). Five bone artifacts (an awl, a complete bone tube, and three incomplete bone tubes) were recovered and later identified (Walker 1984). Although their awl is slightly different in form from the four recovered during the most recent excavations, the combined samples of awls and bone tubes are characteristically representative of items recovered from three sites of similar age in the surrounding area (Bower et al. 1986:17, 55-58; Smith 1987c; Schroedl 1985:79-81). Including the tube discards, the entire modified bone collection from 48SW5057 resembles (in one way or another) collections from numerous sites which represent different time periods, site types, and geographic locations (Dalley 1972:119-135; Falk 1983:14.3-14.11; Frison 1965:86-87; 1967:18-20; 1970:24-26; 1971:272-276; 1973:66; Frison et al. 1978:24-27; Gross and Howes 1986:95; Harrington 1933:136-137; Hustad 1969:39, 55, 63; Lindsay et al. 1968: 56-60, 113-114, 182-183, 316-318; Lucius 1980:97-103; Plimpton 1980: 143-156; Reher and Frison 1980:25-27; Schroedl 1985:79-87; Walker 1981:8; 1982:273).

Miscellaneous

Modified Shell

One fragment of a modified bivalve mollusk shell (Figure 4f) was recovered from Buffalo Hump. This specimen weighs ca. 2.2 grams, and its maximum length and width are ca. 42 mm and 20 mm, respectively. The specimen represents the dorsal fragment of the right valve.

The remains of a small circular hole are centered ca. 0.8 mm from the postero-dorsal border. The specimen displays a recent, fairly even, diagonal break directly through this hole such that only about two-thirds of the original hole remains. It appears that the hole was originally ca. 2-3 mm in diameter.

It appears to have been drilled in a very controlled manner, with some type of sharp object such as a tapered lithic flake. The hole still displays very slight tapers on both sides of the shell (more on the inside than on the outside) which could be the result of at least two processes.

The drilling process may have been initiated on the inner surface of the shell and halted just as the drilling tool began breaking through the outer surface. The hole could then have been completed from the outer surface. This would have prevented excessive damage to or flaking of the nacre layers. A second process which may have produced the tapered condition of the hole may have been wear from a leather thong, although the fairly sharp inner edge along the diameter of the hole is less suggestive of this possibility than the first. No other cultural modifications can be detected.

This specimen probably represents some type of pendant or decorative item which was suspended by a string or thong. A specimen very similar in form and modification is discussed and illustrated in a report on the Breeden Site from South Dakota (Brown 1974:40, Plate 24).

There is no clue as to its original shape. It may have been an entire half shell specimen, or it may have been modified to a desired shape.

Specimens of modified shell have been recovered from various sites in Wyoming (Frison 1971:276; 1973:68; Husted 1969:39; Smith 1987c; Walker and Todd 1984:54). Additional sites in Wyoming have produced shell fragments of questionable cultural association (Frison et al. 1978:37; Scott and Wilson 1984:52). The small size and fragmented nature of the specimen recovered from Buffalo Hump allows only a general taxonomic identification to the family Unionidae. The specimen closely resembles a specimen recovered from the Taliaferro site and identified as Margaritifera sp. (Smith 1987c), which is common in drainages of the Pacific Ocean (Pennak 1953:747). It also resembles Lampsilus sp. specimens which have been recovered from sites in Wyoming (Frison 1971:276; 1973:68; Frison et al. 1978:37) and is considered a native freshwater mussel (Frison 1971:276). Several rivers and small creeks in southwest Wyoming which support mussel populations may have provided the source for the Buffalo Hump specimen, although trade and transportation networks must be considered also.

Modified Juniper Seed

An unburned juniper seed modified as a bead was recovered from the fill of Feature 36 in Component 2. The seed was identified as Utah juniper (Juniperus osteosperma), the seeds of which have naturally hollow centers so that production of beads requires only the removal of the solid ends to achieve a complete perforation. This specimen (FFB18.509) appears to have been manufactured in this manner, with subsequent grinding of one end to make it uniform and rounded. No further modification is apparent on the remainder of the seed's surface.

Documentation of juniper seed beads is rare in the archaeological literature from this area. The near absence of juniper seed beads may be a result of poor preservation and recovery techniques, in which the use of $\frac{1}{4}$ inch mesh for sieving would fail to retain such small items. At the Espy-Cornwell site (48CR4001), located about 100 km south-southeast of Buffalo Hump, over 1000 juniper seed beads were recovered with a burial from which a radiocarbon age of 890 years was obtained (Truesdale 1984). No other sites from within several hundred kilometers have produced such evidence. Farther away, juniper seed beads were recovered from Pit House 9 at Broken Flute Cave, a Basketmaker site dating to about A.D. 550 in northeastern Arizona (Morris 1980).

The bead from the Buffalo Hump site is significant not only because these artifacts are uncommon in the area but because no such trees are presently found within a considerable distance of the site. Its presence indicates that the site occupants obtained the seed and probably made the bead at some time before arriving on the site. Most likely they would have encountered junipers during the course of their yearly round as they passed in and out of the Great Divide Basin.

APPENDIX C

Faunal Analysis

Michael Bergstrom

A total of 1995 faunal specimens, weighing 956.1 grams, was recovered from four cultural components at the Buffalo Hump site (48SW5057). These specimens are the result of an intensive excavation program initiated in the fall of 1985 and completed in the spring of 1986 by Archaeological Services of Western Wyoming College (AS-WWC). Complete and incomplete bone and teeth remains from small, medium, and large animals are represented as archaeological or nonarchaeological specimens. The modified bone specimens (tools, decorative items, and miscellaneous objects) are discussed in Appendix B. Several small fragments of mussel shell were recovered and are briefly mentioned in the conclusion section of Component 3.

The methods employed during the analysis of this faunal material are discussed in detail prior to the presentation of the raw data compilations. Interpretative observations will be provided, based on the entire faunal assemblage, as a conclusion to the faunal analysis.

METHODS

An assemblage of faunal material representing both archaeological and nonarchaeological specimens recovered from a site and subjected to detailed analysis may prove very helpful by providing various insights for the reconstruction of the site's past. The local fauna, the favored animal food, butchering methods, seasonality, and site function are just a few of the problems which may be addressed. Temporal comparisons within the site may be further attempted. In addition, comparisons between sites of different cultural, chronological, and geographical settings may be possible. It is with these ideas that AS-WWC approaches an assemblage of faunal material and subjects it to analysis.

Each faunal specimen is analyzed individually, and its attributes are recorded as raw data on FORTRAN coding forms in the following order: AS-WWC ancillary study specimen number; provenience (general); element type; element orientation; taxonomic identification; modifications; age; length (in centimeters); weight (to the nearest 0.1 gram); in situ provenience; and additional remarks, such as sex, specific taxon, specific element, and test unit designations (see Harrell and Swenson 1986). Some of these attributes require additional explanation.

Numerous sources for element identification were utilized during the initial faunal analysis of material recovered from Buffalo Hump. Primary sources included the comparative collections at AS-WWC and at the Department of Anthropology, University of Wyoming, Laramie. Secondary reference sources included Brown and Gustafson (1979), Burt (1960), Gilbert (1980), Lawrence (1951), and Olsen (1960). Specimens are identified to element as specifically as possible, i.e., 2nd phalange, left radius, or axis vertebra. For incomplete specimens, detailed orientational characteristics are provided which may later prove helpful in determining such aspects as minimum number of individuals (MNI) and butchering techniques. Taxonomic identifications are attempted using a specific to general classification scheme. Genus and species identification is usually possible for complete specimens which are in good condition. As a specimen's condition (completeness and physical character) decreases, family, order, and class assignments are utilized. The most general taxonomic categories, small through large mammals, are incorporated by postulating the approximate animal

size a specimen may represent. Usually this applies to small, fragmented specimens and is based upon the thickness of the bone wall, the size of the incomplete element, or some other characteristic. The categories small to medium and medium to large allow overlap among the three main categories and provide the analysts a means of describing the smaller, unrecognizable fragments. A clarification must be made concerning incomplete specimens from small to medium mammals and birds. Often it is impossible to distinguish mammal bone fragments from bird bone fragments, and thus they may be unintentionally grouped together. Therefore, when addressing the small and medium mammal categories the reader should be aware that these groups may be better considered as animals rather than mammals.

A practice which is ideally avoided at all costs during the initial analysis is the identification or classification of a specimen based on association. For example, positive identification of one or more specimens as Antilocapra americana is not the basis for assignment of all possible elements to pronghorn until a taxon such as Odocoileus sp. has been positively ruled out. Similar problems may arise concerning specimens from Bison and Cervus as well as numerous medium and small animals. Upon completion of the initial analysis it may be acceptable to interpret association of many of the specimens to specific taxa, but these interpretations are not presented as statements of fact.

Five types of bone modification addressed during the faunal analysis are degree of surface weathering, presence of spiral fractures, degree of burning, evidence of butchering, and evidence of tool or decorative specimens. These modification types are helpful in identifying the presence or degree of environmental or cultural agent activity at a site.

Surface weathering is considered a natural modification that reflects the duration or intensity of exposure to which a specimen's surface has been subjected. The term "exposure" implies above ground modifying agents, such as moisture, wind, and temperature, as well as subsurface agents such as soil acids, roots, worms, and microbes. Surface weathering characteristics are based on a scheme presented by Behrensmeyer (1978:151). No specimens are represented by Stage 0. All rodent and other materials which are believed to be nonarchaeological, intrusive, or of recent origin are assigned to Stage 1. Specimens which appear to be in good condition with fairly intact surfaces are assigned to Stage 2. Specimens assigned to Stage 3 are characterized as having a rough, pitted surface. Stage 4 specimens are fragile and appear cracked and often lose small or large splinters when moved. Stage 5 specimens are extremely fragile and usually crumble when touched or handled. It should be noted that these stages are not exclusively defined so as to allow easy specimen assignment. These stages graduate from one to another, and at times a specimen may contain characteristics from two or more stages and thus fit equally well in two or more adjacent stage categories. In these cases, surface area percentages are calculated for the stages appearing on a specimen and the larger percentage is considered the representative stage.

The results from surface weathering analysis should be studied carefully before offering any suggestions as to their meaning. Some factors to consider during an analysis are the agents responsible for the accumulation of the faunal assemblage, i.e., human or animal predation, disease, starvation, or natural death, the site habitat, in

terms of past and present environment and the affect of habitat on the degree of bone preservation (Behrensmeyer 1978:58-59); the methods of handling and preparing bone specimens prior to analysis; and the differences in bone preservation due to animal size or age (Behrensmeyer 1978:160; Von Den Driesch 1976:5). Addressing these and other similar problems help to reduce ambiguity within a faunal assemblage and produce more accurate results.

Spiral fractures are modificational attributes produced by either cultural or noncultural processes and are described in Gilbert (1980:11-14) and Haynes (1983:104). Basically these specimens have broken edges which are angled or spirally shaped in profile rather than straight or even. The presence of spiral fractures will not be considered as direct evidence for cultural activity (Gilbert 1980:9-10; Haynes 1980:341; 1982:279; 1983:113; Lyman 1984:315; Myers et al. 1980:488) but will be interpreted as possible evidence for cultural activity, i.e., marrow extraction or bone reduction for juice or grease (Binford 1978:157-165). The following specimen types are not considered when determining presence or absence of spiral fractures: recent or intrusive rodent material, teeth fragments, small compact bone wall fragments, cancellous bone, and articular surface fragments.

The three remaining modification types are considered products of cultural activities. Four degrees or stages of burning are defined: (1) partial burn, in which only a small (less than 10%) portion of the specimen is discolored or blackened by heat or fire, (2) complete burn, in which most (at least 90%) or all of the specimen is burned to a coal black color, (3) partial calcine, which is similar to Stage 2 with the addition of traces of bluish white areas on the specimen's surface, and (4) complete calcine, in which most (at least 90%) or all of the specimen is burned to a bluish white color. Variations in degree of burning imply the length of time or the intensity of heat to which a specimen has been subjected. When this attribute is included with additional statistics, such as specimen number, size, element type, and taxon, it becomes an equally important aspect to consider when trying to hypothesize a site's function.

Evidence of butchering in the form of chop or cut marks on specimens, along with their location on identified elements, may provide insight as to the methods used to butcher or process animals. Specimens identified as tool or decorative items are discussed in Appendix B.

Specimens which allow specific age assignments are usually limited to elements such as maxillae and dentaries (number of teeth and degree of eruption). More general age categories (such as fetal, immature, and adult) are utilized when examining specimens for size or degree of epiphyseal fusion, although this latter method should be used cautiously as epiphyseal sutures are visible in specimens representing both immature and adult animals (Von Den Driesch 1976:4). This information is a major source for determining MNI and the season of site occupation. Identification of the sex of individuals also is useful in calculating MNI. Various procedures aimed toward determining sex deal with measuring certain skeletal elements, noting the development of specific tuberosities, or noting the presence of certain skeletal elements (Gilbert 1980; Burt 1960).

Specimen size (length in centimeters) and weight (to the nearest 0.1 gram) are statistical attributes which primarily indicate degree or intensity of bone reduction. Specimen numbers by size and weight for

different taxa or animal sizes, in relation to intracomponent distribution, allow possible identification of activity areas as well as intercomponent comparisons.

Space is provided near the end of the computer coding form for additional information such as in situ provenience, detailed specimen identification, specimen relation to each other or to features, and sex of taxon representing specimen.

The format presented within this computer analysis is designed to extract the maximum amount of information from individual specimens. This information is gradually combined to produce fragments of knowledge about a particular site. In the end, the entire faunal assemblage reflects various aspects about a site, and ideally, these aspects are fairly accurate representations.

RESULTS

The faunal assemblage from Buffalo Hump is presented by count (N) and weight (grams) for each cultural component based on two general categories: archaeological and nonarchaeological material (Table 1). Identified and unidentified taxa specimens are presented only within the "Archaeological Material" category. Identified taxa specimens are usually fairly complete elements or are incomplete elements that display one or more characteristic attributes which enable specific taxa assignment. Unidentified taxa are small, fragmented specimens which allow only the most generalized animal size assignments.

The percentage figures presented in Table 1 allow two separate comparisons to be made. The percentages by column are descriptions of the breakdown of multiple variables within each component. The percentages by row are comparisons of a single variable within all components. A word of caution is in order at this time concerning the specimens designated to the unassigned component. These specimens (70 by count or 64.0 grams by weight) are considered a part of the site, but from contexts which could not be assigned to components. The fact that they cannot be incorporated into specific components should not be cause to disregard them completely. They will be presented separately as tabulated data along with the rest of the material (though not included in overall totals), but any further discussion about or reference to them will be excluded unless otherwise noted.

Nonarchaeological material is usually identified by the stage of surface weathering which it displays, usually Stage 0 or 1 (Behrensmeyer 1978:151). A detailed breakdown of noncultural material is present in Table 2. These data are most useful in the following ways: they provide a list of recent fauna which may be used to compare sites in the immediate or surrounding area, they provide a list from which to compare reconstructed faunal assemblages through time, and they provide a general idea as to the variety and number of species per cubic meter in an area. More and more attention is being focused upon the role which small mammals may have played in prehistoric diets. Their availability and presence in large numbers around activity areas is well known to modern campers and is probably representative of prehistoric times. Many of these small mammals could have been consumed whole (Stahl 1982: 827; Stewart and Stahl 1977:269; Swanton 1946:368-369), which would partially account for their limited recovery in archaeological sites. Although

Table 1. Summary of total faunal material, by count (N) and weight (grams), recovered from the Buffalo Hump site.

		COMPONENT										Unassigned Component**	
1		2		3		4		Total					
N	grams	N	grams	N	grams	N	grams	N	grams	N	grams	N	grams
Archaeological material													
Identified taxa													
% Column	5	3.7	56	68.0	24	100.1	1	2.5	86	174.3	11	12.8	
% Row	17.9	8.7	7.9	14.1	4.6	32.7	50.0	89.3	6.9	20.9	15.7	20.0	
	5.8	2.1	65.1	39.0	27.9	57.4	1.2	1.5	100.0	100.			
Unidentified taxa													
% Column	23	38.8	652	412.8	493	205.8	1	0.3	1169	657.7			
% Row	82.1	91.3	92.1	85.9	95.4	67.3	50.0	10.7	93.1	79.1	59	51.2	
	2.0	5.9	55.7	62.8	42.2	31.3	0.1	*	100.0	100.0	84.3	80.0	
Subtotals													
% Column	28	42.5	708	480.8	517	305.9	2	2.8	1255	832.0	70	64.0	
% Row	68.3	90.2	65.1	93.4	68.8	95.1	100.0	100.0	66.7	93.9	61.9	91.6	
	2.2	5.1	56.4	57.8	41.2	36.8	0.2	0.3	100.0	100.0			
Nonarchaeological material													
% Column	13	4.6	380	33.8	234	15.8	-	-	627	54.2	43.0	5.9	
% Row	31.7	9.8	34.9	6.6	31.2	4.9			33.3	6.1	38.1	8.4	
	2.1	8.5	60.6	82.4	37.3	29.1			100.0	100.0			
Total													
% Column	41	47.1	1088	514.6	751	321.7	2	2.8	1882	886.2	113	69.9	
% Row	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
	2.2	5.3	57.8	58.1	39.9	36.3	0.1	0.3	100.0	100.0			

*less than 0.1

**not included in overall totals

only three rodent specimens are deemed archaeological from Buffalo Hump, this number probably underestimates the dietary role which these animals played at this site. Thus, Table 2 will function only as an incomplete representation of small animals that are presently found at Buffalo Hump.

Natural Modifications

The entire archaeological faunal assemblage from Buffalo Hump displays various stages of surface weathering. As mentioned previously, these stage assignments follow those presented by Behrensmeyer (1978:151). No specimens are assigned to Stage 0. Stage 1 specimens consist of recent intrusive material (Table 2) and will not be further discussed. The majority of specimens (Table 3) are represented by Stages 2 (50.4% and 48.4% by number and weight, respectively) and 3 (49.6% and 51.6% by number and weight, respectively). This represents almost an equal distribution of specimens between the two stages. The specimens assigned to Stage 5 represent the weathered remains of one unidentified vertebra. These fragments are in such poor condition that excessive handling results in further crumbling because most of the protective, outer, compact bone layer has weathered away.

Two specimens display teeth marks and fracture patterns which closely resemble specimens from previously documented carnivore activity (Haynes 1980:344; 1981:270, 274; 1983:108). Teeth marks are usually not too difficult to identify unless the specimen is in an advanced stage of surface weathering. As surface weathering stages increase, identification of carnivore versus cultural modification is hindered due to the similarities which each activity produces. The possibility that additional carnivore-modified specimens are present within the faunal assemblage should not be overlooked and will be discussed further in the section on spiral fractures.

Taxonomic Classification

A total of six taxa was identified from the material recovered from Buffalo Hump. These include bison (Bison bison), pronghorn (Antilocapra americana), coyote or dog (Canis sp.), bobcat (Felis rufus), badger (Taxidea taxus), and jackrabbit (probably white-tailed, Lepus townsendii; Walker 1984). Specimens unidentifiable to taxa are assigned to various mammal size categories, and bird and rodent specimens are generally assigned as such (Table 4). Also, specimen counts and weights are included within each component category. Specimen counts are most useful in determining the MNI (White 1953:397) per species or the estimation of consumed meat (Lyman 1979:539, 544). Specimen weights are presented, but their detailed incorporation into the analysis is limited. There are too many inaccuracies involved when attempting to calculate meat weight from bone weight (Grayson 1984:172-174; Lyman 1979:538). Thus, these figures are provided only to allow the development of general intrasite comparisons. Percentages are provided in Table 4 which allow for intracomponent analyses on frequency distribution.

Table 5 presents counts and frequencies of all faunal material based on two general animal sizes. The specimens identified to taxa seem easily separable into these two categories: bison and pronghorn

Table 3. Stages of surface weathering by count (N) and weight (grams) in the faunal remains from the Buffalo Hump site.

	COMPONENT										Unassigned Component	
	1		2		3		4		Totals			
	N	grams	N	grams	N	grams	N	grams	N	grams		
Stage 2 % Column % Row	20 71.4 3.2	38.2 89.9 9.5	407 57.5 64.4	278.2 57.9 69.0	203 39.3 32.1	83.7 27.4 20.8	2 100.0 0.3	2.8 100.0 0.7	632 50.4 100.0	402.9 48.4 100.0	34 48.6	16.6 25.9
Stage 3 % Column % Row	8 28.6 1.3	4.3 10.1 1.0	301 42.5 48.3	202.6 42.1 47.2	314 60.7 50.4	222.2 72.6 51.8	-	-	623 49.6 100.0	429.1 51.6 100.0	23 32.9	11.0 17.2
Stage 5 % Column % Row	-	-	-	-	-	-	-	-	-	-	13 18.5	36.4 56.9
Total % Column % Row	28 100.0 2.2	42.5 100.0 5.1	708 100.0 56.4	480.8 100.0 57.8	517 100.0 41.2	305.9 100.0 36.8	2 100.0 0.2	2.8 100.0 0.3	1255 100.0 100.0	832.0 100.0 100.0	70 100.0	64.0 100.0

Table 4. Summary of the total faunal material, by count (N) and weight (grams), by taxon at the Buffalo Hump site.

Taxon	COMPONENT						Totals		Unassigned Component	
	1	2	3	4	Totals	Unassigned Component	N	grams	N	grams
Bison	-	-	5 (0.7)	14.0 (2.9)	3 (0.6)	89.4 (29.2)	-	-	8 (0.6)	103.4 (12.4)
Pronghorn	1 (3.6)	1.8 (4.2)	1 (0.2)	0.5 (0.1)	-	-	1 (50.0)	2.5 (89.3)	3 (0.2)	4.8 (0.6)
Artiodactyl	4 (14.3)	32.6 (76.5)	6 (0.9)	25.4 (5.3)	-	-	-	-	10 (0.8)	57.9 (7.0)
Coyote or dog	-	-	1 (0.2)	0.8 (0.2)	4 (0.8)	1.3 (0.4)	-	-	5 (0.4)	2.1 (0.2)
Bobcat	-	-	8 (1.1)	8.1 (1.7)	-	-	-	-	8 (0.6)	8.1 (1.0)
Badger	-	-	10 (1.4)	25.6 (5.3)	-	-	-	-	10 (0.8)	25.6 (3.1)
Jackrabbit	4 (14.3)	1.9 (4.5)	31 (4.4)	19.0 (4.0)	17 (3.3)	9.4 (3.1)	-	-	52 (4.1)	30.3 (3.6)
Large mammal	2 (7.1)	3.2 (7.5)	306 (43.2)	320.9 (66.5)	138 (26.7)	151.0 (49.4)	-	-	446 (33.5)	475.1 (57.1)
Medium to large mammal	15 (53.5)	2.8 (6.6)	309 (43.6)	62.7 (13.0)	250 (48.3)	49.8 (16.3)	1 (50.0)	0.3 (10.7)	575 (45.8)	115.6 (13.9)
Medium mammal	1 (3.6)	0.2 (0.5)	9 (1.3)	1.6 (0.3)	16 (3.1)	2.2 (0.7)	-	-	26 (2.1)	4.0 (0.5)
Small to medium mammal	1 (3.6)	0.1 (0.2)	20 (2.8)	2.1 (0.4)	73 (14.1)	2.5 (0.8)	-	-	94 (7.5)	4.7 (0.6)
									9 (1.1)	0.7 (1.1)

Table 4. Concluded.

Taxon	1		2		3		4		Total		Unassigned Component	
	N	grams	N	grams	N	grams	N	grams	N	grams	N	grams
Bird	-	-	1 (0.2)	0.1 (*)	-	-	-	-	1 (0.1)	0.1 (*)	-	-
Rodent	-	-	1 (*)	* (*)	16 (3.1)	0.3 (0.1)	-	-	17 (1.4)	0.3 (*)	-	-
Total	28	42.5	708	480.8	517	305.9	2	2.8	1255	832.0	70	64.0

*less than 0.1

Key: () = percent by column

Table 5. Counts (N) and frequencies of faunal material by general animal size at the Buffalo Hump site.

Taxonomic group	COMPONENT				Total	Unassigned Component
	1	2	3	4		
Identified						
Large animals	1	6	3	1	11	-
% Column subtotal	20.0	10.7	12.5	100.0	12.8	
% Column total	3.6	0.8	0.6	50.0	0.9	
Small animals	4	50	21	-	75	11
% Column subtotal	80.0	89.3	87.5		87.2	100.0
% Column total	14.3	7.1	4.0		6.0	15.7
Identified taxa						
Subtotals	5	56	24	1	86	11
% Column totals	17.9	7.9	4.6	50.0	6.9	15.7
Unidentified						
Large animals	21	621	388	1	1031	48
% Column subtotal	91.3	95.2	78.7	100.0	88.2	75.0
% Column total	75.0	87.7	75.1	50.0	82.1	68.6
Small animals	2	31	105	-	138	11
% Column subtotal	8.7	4.8	21.3		11.8	17.2
% Column total	7.1	4.4	20.3		11.0	15.7
Unidentified taxa						
Subtotals	23	652	493	1	1169	64
% Column totals	82.1	92.1	95.4	50.0	93.1	91.4
Total	28	708	517	2	1255	70

specimens into the large animal category, and coyote or dog, bobcat, badger, and jackrabbit specimens into the small animal category. The specimens unidentified to taxa consisting of artiodactyls, large, and medium to large mammals are included in the large animal category whereas the unidentified specimens of medium and small to medium mammal, bird, and rodent specimens are included in the small animal category. Percentages by column are provided as subtotals which show frequencies within the two categories (identified and unidentified animals) and as totals which show frequencies within the entire component. Table 6 is a list of MNI by cultural component.

Anatomical Elements

Tables 7, 8, 9, 10, and 11 present the entire faunal assemblage from the site by cultural component. All specimens are identified as completely and accurately as possible. These data are presented in each table as follows: element, count, portion, body side, and taxon or animal size. Component 2 is presented as identified and unidentified taxa (Tables 8 and 9, respectively). All unassigned component material is presented in Table 11, but this material will not be addressed at this time.

Skeletal elements of minimal variety are represented in Component 1 (Table 7). All of the large mammal specimens (taxa and nontaxa identified) are single, incomplete element representations. These specimens are long bone fragments (rib, femur, or tibia) or distal limb elements. No cranial elements are represented. Jackrabbit and small to medium mammal specimen representation suggests a slight increase in variety of skeletal elements, and in one respect this is understandable. An entire small animal carcass can be transported easier than a large animal carcass (unless butchered). Selected parts or butchering units (Lyman 1979:539) from large animals can be easily transported, leaving the less desired body parts at the kill area. Also, it is possible that large animal carcasses were processed as butchering units and, therefore, different areas of a site would contain only certain skeletal elements. Smaller animals are easily processed as a whole (in one place); thus their remains may tend to be less scattered. The presence of smaller animal elements suggests that these animals were not being totally utilized.

A similar scheme can be seen in Components 2 and 3. Very few cranial fragments are noted in all animal size ranges except jackrabbit. Vertebra specimens are represented in minor amounts in Component 2 for medium-sized mammals (N=4) and in Component 3 (N=3). Long bone fragment frequencies increase only slightly in both components. Rib bodies are most commonly represented in larger animal groups for Components 2 (N=3) and 3 (N=2). Distal limb bones (primarily podials and phalanges) are also represented for larger animals (three in Component 2 and two in Component 3). In both Components 2 and 3, jackrabbits are represented by significant numbers of a variety of skeletal elements. Component 2 contains 31 jackrabbit specimens representing 13 different elements, whereas Component 3 contains 17 specimens representing nine different elements.

A total of 77 long bone shaft fragments within both components are probably the remains of jackrabbits. A majority of the 864 long bone shaft fragments from medium to large and large mammals probably

Table 6. Minimum number of individuals (MNI) by taxon for component at the Buffalo Hump site.

Taxon	COMPONENT				Unassigned Component
	1	2	3	4	
Bison	-	1	1	-	-
Pronghorn	1	1	-	1	-
Coyote or dog	-	1	1	-	-
Bobcat	-	1	-	-	-
Badger	-	1	-	-	-
Jackrabbit	1	2	2	-	2
Bird	-	1	-	-	-
Rodent	-	1	1	-	-

represent the remains of long bone elements from bison and pronghorn. These numbers suggest intensive nutrient recovery activities in the form of bone reduction in both components. The intensity of reduction was probably less for jackrabbit bones than for large animal bones, considering the amount of nutrient return versus energy input, although the smaller bones appear to have been processed to some degree (see Table 12).

Cultural Modification

Three types of cultural modification are exhibited on specimens from Buffalo Hump. The first type, butchering marks, is possibly represented by one specimen. The specimen is a fragment of a large mammal rib body. Very faint striations are discernible on its surface and appear to be the remains of lithic cut marks. Due to the surface weathering stage of this specimen (Stage 3), definitively observable cultural modification is not apparent.

The second type of cultural modification present within the faunal material is burning. A total of 157 specimens (29.5 grams), representing 12.5% and 3.5% by number and weight respectively from all four components, exhibit some degree of burning (Table 13). Counts, weights, and frequencies for each component as well as the relationship of each component to the others are included in Table 13. Equal frequencies (7.1%) of burned specimens are contained in Components 1 and 2, and a significant increase (almost three times) is noted in Component 3 (20.3%). These three components are almost equal when considering the weight of bone involved (3.0% to 3.9%). The majority of burned specimens (by number and weight) are contained within Components 2 and 3.

The different degrees of burning for each component are presented in Table 14. Counts (N) and weights (grams) are indicated, along with their frequencies, within each component. Component 2 is dominated (by count and weight) by specimens with partial burn, partial calcine, and complete burn degrees in that order. Component 3 is dominated by either partial or complete burn degrees, depending on the index of count or

Table 7. Elements represented by taxon for Component 1 at the Buffalo Hump site.

Element	Pronghorn	Artiodactyl	Jackrabbit	Small to medium mammal	Medium mammal	Medium to large mammal	Large mammal	Total
dentary	-	-	1 poR	-	-	-	-	1
rib	-	-	-	-	1b	1b	1b	3
scapula	-	-	-	1g	-	-	-	1
humerus	-	-	1d1	-	-	-	-	1
metacarpal	-	1s	-	-	-	-	-	1
1st phalange	1pr	1pr	-	-	-	-	-	2
femur	-	1s1	1poR	-	-	-	-	2
metatarsal	-	-	1prR	-	-	-	-	1
metapodial	-	1pr	-	-	-	-	1s	2
long bone shaft fragment	-	-	-	-	-	13	-	13
articular surface	-	-	-	-	-	1	-	1
Total	1	4	4	1	1	15	2	28

Key: L = left
R = right
pr = proximal
d = distal
po = posterior
s = shaft
b = body
g = glenoid

Table 8. Elements by identified taxon for Component 2 at the Buffalo Hump site.

Element	Bison	Pronghorn	Coyote or dog	Bobcat	Badger	Jackrabbit	Total
dentary	-	-	-	-	-	3mL(2),R	3
premaxilla	-	-	-	-	-	2FL,R	2
tooth fragment	-	-	-	-	-	1	1
incisor unknown	1	-	-	-	-	-	1
thoracic vertebra	-	-	-	-	2	-	2
scapula	-	-	-	-	-	1gL	1
humerus	-	-	-	-	1L	-	1
ulna	-	-	-	-	-	3prL(2),R	3
radius	-	-	-	-	-	5prL(2)R,dLR	5
metacarpal	-	-	-	1	-	-	1
sesamoid	2	1	-	-	-	-	3
1st phalange	1h	-	-	1	-	-	2
2nd phalange	1h	-	-	1	3	1	6
3rd phalange	-	-	-	-	1	-	1
innominate	-	-	-	-	-	1mR	1
femur	-	-	-	-	1R	3prLR,d1	4
tibia	-	-	-	-	1L	4s1R,d1,d	5
metatarsal	-	-	-	4pr	-	2pr	6
metapodial	-	-	-	1d	1	4d(3),pr	6
astragalus	-	-	-	-	-	1R	1
baculum	-	-	1	-	-	-	1
Total	5	1	1	8	10	31	56

Key: L = left, R = right, pr = proximal, d = distal, m = middle, s = shaft, g = glenoid,
h = lateral half, F = anterior, () = count

Table 9. Elements by unidentified taxon for Component 2 at the Buffalo Hump site.

Element	Artiodactyl	Small to medium mammal	Medium mammal	Medium to large mammal	Large mammal	Rodent	Bird	Total
cranial fragment	-	3	-	3	-	-	-	6
maxilla	-	1	-	-	-	-	-	1
alveolar fragment	-	4	1	-	-	-	-	5
tooth enamel	1	-	-	-	2	-	-	3
tooth fragment	-	-	-	-	1	-	-	1
incisor unknown	-	-	-	-	-	1	-	1

Table 9. Concluded.

Element	Artiodactyl	Small to medium mammal	Medium mammal	Medium to large mammal	Large mammal	Rodent	Bird	Total
vertebra unknown	-	-	1	1	-	-	-	2
rib	-	-	-	1b	4b	-	-	5
scapula	-	-	1L	1pr	3m	-	-	5
ulna	-	-	-	1Rpr	-	-	1s	2
phalange unknown	3d	1	-	-	-	-	-	4
3rd phalange	-	1	-	-	-	-	-	1
innominate	1Ra	-	-	-	3m	-	-	4
femur	-	-	2pr	-	-	-	-	2
tibia	-	-	1d	-	-	-	-	1
metapodial	1d	-	-	-	-	-	-	1
podial	-	-	-	1	-	-	-	1
articular surface	-	-	-	4	3	-	-	7
long bone shaft fragment	-	10	3	247	263	-	-	523
bone wall compact	-	-	-	1	2	-	-	3
cancellous tissue	-	-	-	49	24	-	-	73
unknown	-	-	-	-	1	-	-	1
Total	6	20	9	309	306	1	1	652

Key: L = left, R = right, pr = proximal, d = distal, m = middle, s = shaft, b = body,
a = acetabulum

Table 10. Elements by taxon for Component 3 at the Buffalo Hump site.

Element	Bison	Coyote or dog	Jackrabbit	Small to medium mammal	Medium mammal	Medium to large mammal	Large mammal	Rodent	Total
cranial fragment	-	-	-	3	1	-	1	-	5
dentary	-	-	1mR	-	1mR	-	-	-	2
maxilla	-	-	1mR	-	-	-	-	-	1
temporal	-	-	-	-	1	-	-	-	1
alveolar fragment	-	-	-	-	2	-	-	-	2
incisor unknown	-	-	-	-	-	-	-	1	1
vertebra unknown	-	-	-	-	-	-	1	-	1
lumbar vertebra	-	-	-	-	-	1	-	-	1
rib	-	-	-	1b	2m	-	3b	-	6
ulna	-	-	1sR	1s	-	-	-	-	2
radius	-	-	5prL(3),R(2)	1prR	-	-	-	-	6
metacarpal	-	-	1pr	-	-	-	-	-	1
1st phalange	-	-	1	-	-	-	-	-	1
3rd phalange	1pr	-	-	-	-	-	-	-	1
innominate	-	-	-	-	-	-	2m	-	2
femur	1pr	-	3prLR,pr	-	1s	-	-	-	5
tibia	-	-	1dR	1ds	-	-	1d	1s	4
metatarsal	-	1pr	-	-	-	-	-	-	1
calcaneum	-	-	1L	-	-	-	-	-	1
astragalus	1L	-	2L,R	-	-	-	-	-	3
podial	-	3	-	-	-	-	-	-	3
articular surface	-	-	-	-	1	4	1	-	6
long bone shaft fragment	-	-	-	66	7	230	124	14	441
bone wall compact	-	-	-	-	-	7	2	-	9
cancellous tissue	-	-	-	-	-	6	2	-	8
unknown	-	-	-	-	-	2	1	-	3
Total	3	4	17	73	16	250	138	16	517

Key: L = left, R = right, pr = proximal, d = distal, m = middle, s = shaft, b = body,
() = count

Table 11. Elements by taxon for unassigned component at the Buffalo Hump site.

Element	Jackrabbit	Small to medium mammal	Medium mammal	Medium to large mammal	Large mammal	Total
cranial fragment	-	-	-	1	-	1
dentary	1R	-	-	-	-	1
tooth fragment	1	-	-	-	-	1
vertebra unknown	-	-	-	-	13	13
rib	-	1b	2b	-	-	3
scapula	1prL	-	-	-	-	1
humerus	3s	-	-	-	-	3
ulna	1pr	-	-	-	-	1
radius	1s	-	-	-	-	1
tibia	2dL,sR	-	-	-	-	2
metapodial	1d	-	-	-	-	1
articular surface fragment	-	-	-	1	-	1
long bone shaft fragment	-	8	-	28	3	39
bone wall compact	-	-	-	1	-	1
cancellous bone	-	-	-	1	-	1
Total	11	9	2	32	16	70

Key: L = left, R = right, pr = proximal, d = distal, s = shaft, b = body

weight, with partial calcine degree being second in either respect. Considering the site as a whole, the order of dominance is partial burn, complete burn, partial calcine, and complete calcine (by count) or partial burn, partial calcine, complete burn, and complete calcine (by weight).

Although 12.5% (by count) or 3.5% (by weight) of the total site assemblage (1255 specimens or 832.0 grams) is burned, upon closer examination it is easy to be misled by numbers which are generated from such a small sample. The evidence for extensive amounts of intentional bone burning does not appear in high frequency. A plausible explanation is that the burned bone represents occasional and isolated bone reduction activities whereby, at the conclusion of the nutrient recovery process, the waste material (bone) was disposed of either in or near a

Table 12. Specimen counts by length for animal size for all cultural components* at the Buffalo Hump site.

Length (cm)	Large	Medium	Small	Total
1	194 (18.2)	2 (4.5)	77 (52.0)	273 (21.8)
2	562 (52.9)	15 (34.1)	32 (21.6)	609 (48.5)
3	191 (18.0)	7 (15.9)	17 (11.5)	215 (17.1)
4	64 (6.0)	2 (4.5)	9 (6.1)	75 (6.0)
5	23 (2.1)	-	2 (1.4)	25 (2.0)
6	10 (0.9)	1 (2.3)	4 (2.7)	15 (1.2)
7	4 (0.4)	-	2 (1.4)	6 (0.4)
8	5 (0.5)	-	-	5 (0.4)
9	-	1 (2.3)	-	1 (0.1)
10	2 (0.2)	-	-	2 (0.2)
11	1 (0.1)	-	-	1 (0.1)
12	1 (0.1)	-	-	1 (0.1)
Complete	6 (0.6)	16 (36.4)	5 (3.4)	27 (2.1)
Total	1063	44	148	1255

* table does not include material from unassigned component

Key: () = Percent by column

firepit. Tables 15 and 16 suggest this possibility. Only 20 (12.7%) of the total 157 burned specimens can be identified to element, whereas 137 (87.3%) specimens are only generally identified. The frequencies produced using weight (35.9% identified specimens versus 64.1% unidentified specimens), while not reflecting as wide a range as the specimen count frequencies, can be easily understood. Identifiable specimens are usually fewer in number, represent fairly complete elements, and usually weigh more. Conversely, unidentifiable specimens are usually more numerous, represent incomplete or small, fragmented elements, and usually weigh less.

Table 13. Burned bone counts (N) and weights (grams) by component at the Buffalo Hump site.

	COMPONENT				Total	Unassigned Component
	1	2	3	4		
Specimen total						
N	28	708	517	2	1255	70
grams	42.5	480.8	305.9	2.8	832.0	64.0
Burned total						
N	2	50	105	-	157	22
grams	1.3	18.9	9.3	-	29.5	7.6

Component total						
% by N	7.1	7.1	20.3	-	12.5	-
% by grams	3.1	3.9	3.0	-	3.5	-
Site total*						
% by N	0.1	4.0	8.4	-	100.0	-
% by grams	0.2	2.3	0.7	-	100.0	-

*these figures are based on count (N = 1248) and weight (grams = 829.5)

Table 14. Degree of burning, by count (N) and weight (grams), by component at the Buffalo Hump site.

Degree of burning	COMPONENT				Total	Unassigned Component
	1	2	3	4		
Partial burn						
N	-	37(74.0)	24(22.8)	-	61(38.9)	5
grams	-	15.5(82.0)	4.5(48.4)	-	20.0(67.8)	6.1
Complete burn						
N	-	2(4.0)	49(46.7)	-	51(32.5)	2
grams	-	0.8(4.2)	1.4(15.0)	-	2.2(7.5)	0.1
Partial calcine						
N	1(50.0)	11(22.0)	29(27.6)	-	41(26.1)	15
grams	0.3(23.1)	2.6(13.8)	3.3(35.5)	-	6.2(21.0)	1.4
Complete calcine						
N	1(50.0)	-	3(2.9)	-	4(2.5)	-
grams	1.0(76.9)	-	0.1(1.1)	-	1.1(3.7)	-
Total						
N	2	50	105	-	157	22
grams	1.3	18.9	9.3	-	29.5	7.6

Key: () = percent by column

Table 15. Taxa identified elements by burn degree, by count (N) and weight (grams) at the Buffalo Hump site.

Taxon/element	Partial burn N	Partial burn grams	Complete burn N	Complete burn grams	Partial calcine N	Partial calcine grams	Complete calcine N	Complete calcine grams	Total N	Total grams
Component 1										
Artiodactyl 1st phalange-proximal	-	-	-	-	-	-	1	1.0	1	1.0
Component 2										
Artiodactyl phalange-distal	2	1.0	1	0.8	-	-	-	-	3	1.8
Jackrabbit femur-L proximal shaft tibia-R shaft	1 -	1.5 -	- -	- -	- 1	- 0.5	- -	- -	1 1	1.5 0.5
Large mammal rib-body	1	1.1	-	-	-	-	-	-	1	1.1
Rodent incisor	-	-	-	-	1	*	-	-	1	*
Component 3										
Jackrabbit ulna-R shaft radius-R distal -R shaft tibia-R distal	1 - 1 -	0.3 - 0.5 -	- 1 1 -	- 0.2 0.5 -	- - - 1	- - - 0.7	- - - -	- - - -	1 1 2 1	0.3 0.2 1.0 0.7
Medium to large mammal articular surface	1	1.5	-	-	-	-	-	-	1	1.5
Medium mammal alveolar fragment ulna-shaft radius-R proximal tibia-distal shaft	- - - -	- - - -	- - - -	- - - -	1 1 1 1	* 0.1 0.2 0.7	- - - -	- - - -	1 1 1 1	* 0.1 0.2 0.7
Rodent incisor tibia	1 -	* -	- 1	- *	- -	- -	- -	- -	1 1	* *
Total	8	5.9	4	1.5	7	2.2	1	1.0	20	10.6

Table 15. Concluded.

Taxon/element	Partial burn N	Partial burn grams	Complete burn N	Complete burn grams	Partial calcine N	Partial calcine grams	Complete calcine N	Complete calcine grams	Total N	Total grams
Jackrabbit										
dentary-R	1	3.5	-	-	-	-	-	-	1	3.5
scapula-L proximal	1	1.3	-	-	-	-	-	-	1	1.3
humerus-shaft	-	-	-	-	1	0.4	-	-	1	0.4
Medium mammal										
rib-body	1	0.2	-	-	-	-	-	-	1	0.2
Total	3	5.0	-	-	1	0.4	-	-	4	5.4

*less than 0.1

Key: R = right
L = left

Table 16. Unidentified specimens by burn degree, by count (N) and weight (grams) at the Buffalo Hump site.

Specimen type/animal size	Partial burn N	Partial burn grams	Complete burn N	Complete burn grams	Partial calcine N	Partial calcine grams	Complete calcine N	Complete calcine grams	Totals N	Totals grams

Component 1										
Long bone shaft fragment medium mammal	-	-	-	-	1	0.3	-	-	1	0.3

Component 2										
Long bone shaft fragment small to medium mammal	2	0.1	-	-	2	0.1	-	-	4	0.2
medium to large mammal	20	3.7	1	*	7	2.0	-	-	28	5.7
large mammal	9	6.5	-	-	-	-	-	-	9	6.5
Cancellous bone	1	0.1	-	-	-	-	-	-	1	0.1
Unknown	1	1.5	-	-	-	-	-	-	1	1.5

Component 3										
Long bone shaft fragment small to medium mammal	6	0.2	32	0.4	12	0.2	3	0.1	53	0.9
medium to large mammal	10	1.2	1	*	12	1.4	-	-	23	2.6
large mammal	2	0.6	-	-	-	-	-	-	2	0.6
rodent	1	*	13	0.3	-	-	-	-	14	0.3
Cancellous bone	1	0.2	-	-	-	-	-	-	1	0.2
Totals	53	14.1	47	0.7	34	4.0	3	0.1	137	18.9

Unassigned Component										
Long bone shaft fragment small to medium mammal	-	-	2	0.1	1	*	-	-	3	0.1
medium to large mammal	1	0.7	-	-	14	1.4	-	-	15	2.1
Totals	1	0.7	2	0.1	15	1.4	-	-	18	2.2

*less than 0.1

Most of the identifiable specimens represent postcranial skeletal elements from various sized animals. The specimens assigned to the long bone shaft fragment category are probably from postcranial skeletal elements also. This would seem plausible from a processing or nutrient recovery standpoint because postcranial long bone elements contribute the majority of foodstuffs, i.e., meat, marrow, bone juice, and bone grease.

The third type of cultural modification, spiral fractures, has been previously addressed (see METHODS). The major problem existing with spiral fractures is whether they represent cultural or natural modification. There are two lines of reasoning which may be used to suggest the association of these spirally fractured specimens with cultural modification. First, the specimens represent a segment of material recovered from around and within features at an archaeological site. Although presence or context of material does not always imply cultural association, in this case, arguments against cultural association are very weak. Second, the majority of numerous small specimens recovered from the site do not appear to have been gnawed or chewed upon; rather, their presence probably represents the discarded products of processing or intensive nutrient recovery activities.

A total of 935 specimens (74.5%), from the total cultural faunal assemblage of 1255 specimens, displays evidence of spiral fractures (Table 17). Only 38 specimens (4.1%) could be assigned to a specific taxon. A total of 81 specimens (8.7%) could be identified to element (Table 18). Almost half of these specimens (36 or 44.4%) are jackrabbit elements. The remaining 45 specimens (55.5%) are represented within the large, medium, and small sized animal categories (both taxa specific and general mammal size). Of the 897 specimens (95.9%) which are generally taxa identified, 891 (99.3%) are within the range of medium to large mammals (including the artiodactyl category).

Fragment Size

A total of 1227 specimens (97.8%) is represented as incomplete elements. The majority (1097 or 89.4%) of these specimens fall within the range of 1 to 3 cm in maximum length (Table 19). This may reflect some type of intensive nutrient recovery activity, such as rendering for bone marrow, juice, and grease.

Table 12 presented a general breakdown of bone length by animal size. Bison and pronghorn are considered large animal; coyote or dog, badger, and bobcat are considered medium animals; and rabbits, rodents, and birds are considered small animals. All specimens initially assigned to the large and medium to large categories are included in the large animal total, whereas specimens initially assigned to the medium to small and small mammal categories are included in the small animal total. The majority of specimens (947 or 75.5%) in the range of 1 to 3 cm lengths are represented within the large animal category. This may be explained by realizing that large bones must be reduced more completely, compared to smaller bones, for optimal success in intensive nutrient recovery. Also, prehistoric people may not have felt the need to spend as much time reducing smaller bone elements which would not have provided as much nutrition. The difference in specimen numbers between medium and small animals (44 versus 148, respectively) may be accounted for by MNI counts. There are possibly 5 jackrabbits

Table 17. Spiral fracture counts by taxon in the faunal remains from the Buffalo Hump site.

Taxon	COMPONENT				Total	Unassigned Component
	1	2	3	4		
Bison	-	-	1	-	1 (0.1)	-
Pronghorn	1 (3.8)	-	-	-	1 (0.1)	-
Artiodactyl	4 (15.4)	1 (0.2)	-	-	5 (0.5)	-
Coyote or dog	-	1 (0.2)	-	-	1 (0.1)	-
Bobcat	-	1 (0.2)	-	-	1 (0.1)	-
Jackrabbit	2 (7.7)	22 (4.0)	10 (2.8)	-	34 (3.6)	9 (26.5)
Large mammal	2 (7.7)	277 (50.8)	133 (36.6)	-	412 (44.1)	2 (5.9)
Medium to large mammal	16 (61.6)	232 (42.6)	215 (59.2)	1 (100.)	463 (49.5)	21 (61.7)
Medium mammal	1 (3.8)	6 (1.1)	4 (1.1)	-	11 (1.2)	2 (5.9)
Small to medium mammal	-	5 (0.9)	1 (0.3)	-	6 (0.6)	-
Total	26	545	363	1	935	34

Key: () = percent by column

(excluding the unassigned component material) represented within the site while there is only 1 each of coyote or dog, badger, and bobcat.

Tabulations similar to those presented in Tables 12 and 19 were performed using specimen weight (rather than specimen number) by length. These results generally indicate that heavy specimens are usually long and light specimens are usually short and that large animal specimens commonly weigh more than small animal specimens. For these reasons, these data are not included.

A total of 28 complete elements (2.2%) is represented from three of the components (Table 20). Most of these elements represent small compact bones (from large animals) which preserve well in archaeological sites, or they are postcranial elements from smaller animals which were not further processed.

Table 18. Identified element counts (N) by taxon which display spiral fractures in the faunal remains from the Buffalo Hump site.

Taxon	Element	N
Component 1		
Pronghorn	1st phalange	1
Artiodactyl	metacarpal-R	1
	1st phalange	1
	femur-L	1
	metapodial	1
Jackrabbit	dentary-R	1
	femur-R	1
Large mammal	rib	1
	metapodial	1
Medium to large mammal	rib	1
Medium mammal	rib	1

Component 2		
Artiodactyl	innominate-R	1
Coyote or dog	baculum	1
Bobcat	metapodial	1
Jackrabbit	dentary-L	1
	scapula-L	1
	ulna-L(2),R(2)	4
	radius-L(3),R(2)	5
	femur-L(2),R(1)	3
	tibia-L(2),R(1)	3
	metatarsal(2)	2
	metapodial(4)	4
Large mammal	rib(4)	4
	scapula(3)	3
	innominate(3)	3
	articular surface fragment	1
Medium to large mammal	rib	1
	articular surface(2)	2
Medium mammal	scapula	1
	tibia	1
	alveolar fragment	1
Small to medium mammal	ulna	1

Component 3		
Bison	3rd phalange	1
Jackrabbit	dentary-R	1
	ulna-R	1
	radius-L(1),R(4)	5
	metacarpal	1
	femur-L(1),(1)	2
	tibia-R	1

Table 18. Concluded.

Taxon	Element	N
Component 3 (continued)		
Large mammal	vertebra	1
	rib(3)	3
	innominate	1
	tibia-R	1
	articular surface fragment	1
Medium to large mammal	articular surface fragment	1
Medium mammal	rib(2)	2
	femur	1
Small to medium mammal	ulna	1
	radius-R	1
	tibia	1
Total*		81

Unassigned Component		
Jackrabbit	scapula	1
	humerus(3)	3
	ulna	1
	radius	1
	tibia-L,R	2
	metapodial	1
Medium to large mammal	articular surface fragment	1
Medium mammal	rib(2)	2
Small to medium mammal	rib	1
	metapodial	1
Total		14

* Sum of Components 1, 2, and 3

Key: L = left, R = right, () element counts

CONCLUSIONS

The following section presents the interpretations derived from the analyses and results for each component. The small number of recovered faunal material from this site, which may actually be representative of the site, allows only minimal interpretations. While interpretations of cultural activities based on these remains are only suggested, they are nonetheless interesting.

Table 19. Specimen counts by length for each component at the Buffalo Hump site.

Length (cm)	COMPONENT				Total	Unassigned Component
	1	2	3	4		
1	4 (14.3)	122 (17.2)	147 (28.4)	-	273 (21.7)	13 (18.6)
2	12 (42.8)	358 (50.6)	238 (46.0)	1 (50.0)	609 (48.5)	32 (45.7)
3	4 (14.3)	134 (18.9)	77 (14.9)	-	215 (17.1)	11 (15.7)
4	3 (10.7)	41 (5.8)	30 (5.8)	-	74 (5.9)	5 (7.1)
5	1 (3.6)	16 (2.3)	8 (1.5)	-	25 (2.0)	2 (2.9)
6	2 (7.1)	10 (1.4)	3 (0.6)	-	15 (1.2)	2 (2.9)
7	-	3 (0.4)	3 (0.6)	-	6 (0.5)	3 (4.3)
8	-	1 (0.1)	4 (0.8)	-	5 (0.4)	
9	-	1 (0.1)	-	-	1 (0.1)	
10	-	1 (0.1)	1 (0.2)	-	2 (0.2)	
11	1 (3.6)	-	-	-	1 (0.1)	1 (1.4)
12	1 (3.6)	-	-	-	1 (0.1)	
Complete	-	21 (3.0)	6 (1.2)	1 (50.0)	28 (2.2)	1 (1.4)
Total	28	708	517	2	1255	70

Key: () = percent by column

Component 1

The 28 specimens recovered from this component include identified material from pronghorn and jackrabbit (see Table 7). It is not difficult to assume that the specimens which are not identified as specific taxa may be directly associated to these two taxa. Most of the specimens represent incomplete postcranial elements (excluding distal limbs). This suggests a butchering or processing activity which emphasizes these elements over cranial or distal limb elements. Some type of nutrient recovery activity is suggested in Table 17 by the presence of spirally fractured specimens (26 or 92.6%) and in Table 19

Table 20. Complete elements by taxon for cultural components at the Buffalo Hump site.

2	COMPONENT 3	4
Bison sesamoid (2) incisor	Coyote or dog podial (3)	Pronghorn 2nd phalange
Pronghorn sesamoid	Jackrabbit 1st phalange calcaneum astragalus	-
Bobcat metacarpal 1st phalange 2nd phalange metatarsal (3)		-
Badger thoracic vertebra (2) 2nd phalange (3) 3rd phalange femur tibia	-	-
Jackrabbit 2nd phalange astragalus	-	-
Medium to large mammal podial	-	-
Total 21	6	1

Key: () = element counts

by small fragmented specimens (23 or 82.1% which are less than 4 centimeters in length).

Component 2

The majority of archaeological material (708 specimens weighing 480.8 grams or 56.4% and 57.8% by number and weight, respectively) from the site is contained within this component. All identified taxa are represented within this component (see Table 6) by at least one individual. The specimens identifying these taxa represent very incomplete skeletons, except in the case of jackrabbits. Butchering units, as defined by Lyman (1979:539), do not appear for any of the large identified taxa (Table 8) simply because of the small specimen number (6) representing bison and pronghorn. This does not imply that large animals were not being utilized at the site. In fact, this may imply just the opposite. A total of 263 long bone shaft fragments (37.1% of the component) is from some type of large mammal, and all appear to have been spirally fractured (see Table 17). All or most of these specimens fall into the maximum length range of 4 centimeters or less (see Table 19). These figures suggest intensive nutrient recovery

activities such as bone marrow and grease extraction (Gilbert 1980:11; Leechman 1951:355; Vehik 1977:169). Assuming that the long bones were the favored marrow and grease producers, their limited recovery as complete or nearly complete elements (within the large animal category) is expected.

The importance or use of the medium sized mammals (coyote or dog, bobcat, and badger) can only be conjectured. A male coyote or dog is represented (tentatively) by the presence of a single incomplete specimen, a baculum. This specimen was compared to wolf (Canis lupus, from the Anthropology Department, University of Wyoming) and red fox (Vulpes vulpes, from AS-WWC) bacula, but final identification was provided by a drawing (Burt 1960:Plate II). This may represent a "pet" of the prehistoric inhabitants at this site or the remains of a coyote which was purposefully sought and killed or simply killed as a nuisance. The poor condition of this specimen (Stage 3) appears to rule out recent intrusion.

The bobcat specimens represent at least one each of the distal front and rear limbs. This may suggest that only the hide was brought back to camp. An ethnogeographic account states that for the Wind River Shoshone "The bobcat or lynx, mink, otter, and weasel had value as fur, but were not eaten" (Shimkin 1947:265). Although there is later reference that the bobcat (wildcat), whose fur was used for babies, was sometimes eaten (Shimkin 1947:278). Among the Great Basin/Plateau Shoshone "Wolves, coyotes, mountain lions, and wildcats were taken with great difficulty and were rarely eaten. Their furs, except that of the wildcat, which was valued for quivers, had no important uses" (Steward 1938:34). The presence of incomplete epiphyseal fusion on three specimens (left metacarpals) suggests a young or immature bobcat.

Badger specimens represent the most varied skeletal elements recovered of all the taxa except jackrabbit. Only two specimens are incomplete, suggesting that most of the carcass was not, or was only partially, utilized. Shimkin (1947:265) noted that the Wind River Shoshone considered the badger an "occasional" animal, i.e., a member of the least important group of animals based on a three category system. Later, badgers are noted in Shoshonean use as being hunted and eaten (Shimkin 1947:276). Reference is also made to the badger that "It was used for food only during times of scarcity but its tough hide was valued for moccasins" (Steward 1938:40). The badger specimens suggest that at least most of the postcranial skeleton was brought back to camp prior to minimal processing. The evidence appears to be strong for suggesting that only the hide was used. The complete nature of most of the specimens do not suggest further processing of the carcass. Incomplete epiphyseal fusion, on both thoracic vertebra, the femur, and the tibia, suggests a young or immature badger.

Jackrabbit specimens are the most numerous identified elements in this component. At least two individuals are represented by a variety of skeletal elements, most of which are incomplete and only two of which are burned. Reference is made in Steward (1938:38) to the large amount of meat provided by jackrabbits from communal hunts, and that hides were used in the manufacturing of blankets or robes. Shimkin (1947:265, 268, 277) notes that jackrabbits were a major but occasional food source, often subject to fluctuations in population and availability. The small MNI represented from this component suggests that jackrabbits were only

an occasional dietary supplement. The presence of modified bone from jackrabbits indicates an additional use for these animals (see Appendix B). Eight tube discards, one tube, and one awl representing various jackrabbit elements, indicate manufacturing of tools and nonutilitarian objects and utilization of this animal for uses other than food or fur items. All of the unmodified specimens appear to represent adult jackrabbits.

The remainder of the nontaxa identified specimens represent various animal sizes and ages (see Table 9). A distal phalange epiphysis is possibly associated to the pronghorn and does suggest a young individual. Two medium to large mammal specimens also suggest immature animals. Two specimens, unidentified long bone fragments, suggest the presence of a medium to large feral animal. One specimen may be a metapodial fragment, displaying part of the internal septum. The majority of specimens (72%) from this component represent unidentified long bone fragments from medium or large animals.

Only 50 specimens (7.1%) of the component total (703) are burned (see Table 8), and 37 (74%) of these represent medium or large animals. The presence of many unburned specimens further suggests intensive bone reduction for nutrient recovery, i.e., bone juice or grease. A burned rodent incisor from Feature 27 suggests possible food use of small animals, but it could also represent an isolated casualty. A small bird ulna shaft recovered from the site may or may not be culturally associated. Its size and condition suggest a more recent intrusion.

Component 3

A total of 517 (41.2%) specimens, representing 305.9 (36.8%) grams, was recovered from this component (see Table 10). Only three taxa, bison, coyote or dog, and jackrabbit, could be identified from this material (see Table 6). The three bison elements, a femur head, a proximal 3rd phalange, and a left astragalus, suggest the presence of a butchering unit. The femur head is clearly separated from the shaft at the epiphyseal margin, suggesting a young or immature individual. The coyote or dog specimens may well be associated with the specimen from Component 2. Because they cannot be definitely associated to each other, they will be tentatively considered as representing two separate individuals. These specimens, a proximal metacarpal and three podials, may be discarded waste material from initial butchering or processing of the animal. The jackrabbit specimens represent the most numerous and varied of skeletal elements of the three taxa. Most of these specimens are incomplete, and five are burned (see Table 15). The presence of an awl (from a pronghorn) and three tubes (from jackrabbits) indicates the use of these animals for more than just food or hides (see Appendix B).

The majority of specimens (354 or 68.5%) from this component are represented by long bone shaft fragments from medium to large and large mammals. A major portion of this material may be associated with the bison. This component contains the majority of burned specimens (105, or 20.3%, by component and 8.4% by site total). Most of these specimens (53 or 50.5%) represent unidentified small to medium mammals, whereas 25 (23.8%) represent medium to large mammals (see Table 16). These specimens may represent the burned remains of discarded material, or they may represent byproducts of marrow recovery activities. Binford

(1978:152-155) details marrow extraction processes by the Nunamiut in which fresh or fairly fresh bone is processed (broken) without the direct application of heat or fire. Reference is made to the Wind River Shoshone that marrow ". . . is eaten both raw and cooked, being roasted in the larger bones by laying them on the coals" (Shimkin 1947:265). Whichever the case prior to marrow extraction, either method would produce waste material which could be discarded in or near a firepit. The presence of 461 specimens (89.5%) which are 3 centimeters or less in length (see Table 19), suggests that additional intensive nutrient recovery activities occurred, such as bone grease or soup production.

Several small fragments of mussel shell were recovered from this component. These specimens are extremely fragile and are continuing to fragment with each handling. There are six fragments, irregularly round in shape, ca. 10 mm in diameter and less than 1 mm thick. Their total weight is only 0.4 grams. They appear to represent associated fragments which could be layered back together to form a thicker shell fragment. Owing to their small size and fragile condition, no cultural modifications are discernible on any of the specimens. Thus, taxonomic identification is not possible for these same reasons. Cultural introduction of these specimens to the site is suggested due to the presence of a culturally modified shell fragment which was recovered from this same component (see Appendix B).

Component 4

Very little detail can be interpreted from the small sample in Component 4. A 2nd phalange from a pronghorn and a long bone shaft fragment from a medium to large mammal are the only faunal materials represented. It is not known whether this is representative of the component or of an activity area not sampled by the excavations.

Unassigned Component

Unfortunately, the material within the unassigned component category could not be accurately assigned to any of the four components. Some of this material represents specimens recovered from test units within and near the excavated block in which the different context of documentation prohibited accurate assignment to components. Also, some of the specimens were recovered in a disturbed context during monitoring of heavy equipment activity at the site. A list of this material is presented in Table 11, but no further attempt was made to incorporate it into or associate it with any particular component.

Discussion

The faunal material recovered from this site represents a very small sample from which to construct interpretative models. The MNI counts for each component suggest a marginal dependency upon animal food. Whether this is a reflection of animal availability, human population size, or both, is not known. All taxa, except jackrabbit, in the four components are represented by only one individual. In all components the element representation from these taxa is very minimal. This can probably be accounted for by the large number of unidentifiable long bone shaft fragments, which implies bone reduction for intensive

nutrient recovery such as juice or grease. Assuming that the recovery from all four components is fairly representative of each component, the faunal remains suggest near-total or selective utilization of bison, pronghorn, and jackrabbit. The presence of coyote or dog, badger, and bobcat in Components 2 and 3 probably represents isolated opportunistic additions to the food or clothing needs of the site inhabitants. Unfortunately, there are no elements present in the entire faunal assemblage which can be used to determine definite animal age or component seasonality.

A number of sites in southwest Wyoming are similar to the Buffalo Hump site. Three sites in particular, Austin Wash (Reiss and Walker 1982; Schroedl 1985), Maxon Ranch (Harrell and McKern 1986), and Oyster Ridge (Zier 1982), are similar in age to Buffalo Hump. The Austin Wash site, dating to 1150 years B.P. (Schroedl 1985:31), contained similar taxa, i.e., pronghorn, bison, canids, and jackrabbits. Most of these taxa are minimally represented as individual animals except for pronghorn (15 individuals). In addition, the significant amount of bone reduction waste material recovered from this site suggests intensive nutrient recovery for marrow, juice, and grease (Schroedl 1985:83-87). The Oyster Ridge site is dated to 1350 years B.P. (Zier 1982:26) and contained, among other taxa, remains from at least three pronghorn. Evidence from this site suggests that bone reduction did occur but was not as intensive an activity as suggested at Buffalo Hump or Austin Wash (Zier 1982:33). The Maxon Ranch site contained a component (IV) dating to 1140 years B.P. (Harrell and McKern 1986:4.59). At least one pronghorn is represented in this component along with a significant amount of reduced bone. This suggests intensive nutrient recovery activities (Harrell and McKern 1986:4.73-4.74).

Two additional sites, located to the west of Buffalo Hump, present a slightly different occupational trend. The Eden-Farson site (Frison 1971:258:284) and the Boar's Tusk site (Martindale 1982:1-12) are both Late Prehistoric or Protohistoric in age and contained a significant number of pronghorn (200+ and 6-7, respectively). Both sites suggest that pronghorn was the major exploited food source and that fairly extensive bone reduction activities had occurred.

Knowledge of pronghorn herding habits and birth periods are incorporated into these sites to help suggest site seasonality. Briefly, early spring occupational sites may be characterized as containing few numbers of represented animals and possible evidence of fetal or newborn individuals (Frison 1971:282; Zier 1982:30; Harrell and McKern 1986:4.73-4.74), reflecting pronghorn herd fragmentation patterns following their birth season. Ideally, fall or early winter occupational sites should contain more numbers of individuals and no evidence of fetal or newborn animals (Frison 1971:258; Martindale 1982:1, 4; Reiss and Walker 1982:15-17; Schroedl 1985:83, 86). The evidence of intensive nutrient recovery or bone reduction may occur in either situation. Near-total utilization or processing of animal products may indicate a fall activity in preparation for the winter (Schroedl 1985:86), or it may indicate a spring activity which, due to the minimal availability of multiple food types and the lean condition and small number of animals, demands more intensive recovery practices (Zier 1982:36). Additionally, the herding habits of pronghorn (and other similar animals), at times may have determined the human population size of particular groups. Spring period occupational groups

may have relied on small numbers of animals, thus the group may have been similarly small. Fall period occupational groups, coinciding with optimal animal numbers (Martindale 1982:4), may have had a larger available food source, thus allowing for larger numbers of people and possibly communal hunting/trapping activities. One problem with this scheme deals with a situation in which the population of a small group of people did not fluctuate significantly throughout the year. A group such as this upon encountering a moderate number of animals may have taken only a limited number of individuals based on their needs and/or their ability. The faunal assemblage reflecting a situation of this type may prove very similar to the situation in which a small group of people is exploiting an area of minimal animal food resources.

The season of occupation for the four components at 48SW5057 is difficult to determine at this time. Due to the small number of specimens recovered from Components 1 and 4 (28 and 2, respectively) seasonality could not be attempted. The faunal evidence from Components 2 and 3 may plausibly suggest various seasons of occupation. Limited numbers of a few taxa are represented in both components. Bison and pronghorn appear to have been almost totally utilized in terms of bone reduction for intensive nutrient recovery. The presence of immature badger and bobcat individuals in Component 2 is difficult to explain. Badgers are usually most active during the night (Lindzay 1982:656), and bobcats are usually most active at twilight and before sunrise (McCord and Cordoza 1982:740). These animals will usually try to avoid direct human confrontation unless provoked. This may suggest intentional hunting or fortuitous acquisition, either of which could occur at any time of the year.

APPENDIX D

Plant Macrofossil Analysis

Craig S. Smith

Samples from 35 of the pit features at the Buffalo Hump site were floated and examined for plant macrofossils. Each sample consisted of 2.5 to 20.0 liters of fill. A total of 10,752 charred seeds or fruits was recovered and identified to 13 taxa. The majority of the plant macrofossils belong to weedy species. Those of goosefoot overwhelmingly dominate the collection. The analysis was conducted to obtain information on the types of seed foods used by the prehistoric peoples of the area and the season of occupation at the site.

The results of this analysis correspond to the overall picture that is emerging concerning the importance of seed foods in the diet of the Late Prehistoric inhabitants of southwest Wyoming. The analyses of fill from many feature types representing most temporal periods provide evidence of a markedly greater reliance on seeds from weedy species during the Late Prehistoric than in the earlier Archaic periods. Seeds from most of these species are available in the late summer and fall, indicating that the Wyoming Basin was occupied at least during this time of year for intensive gathering and processing of seeds for winter stores. To ensure a ready food supply, the prehistoric inhabitants of the area actually may have encouraged the growth of some of these taxa. They may have burned off the vegetation to create a suitable environment for the invasion of the pioneer, weedy species or actually broadcast seeds of desired plants.

METHODS

The samples were processed using an Archaeon water flotation device. This machine consists of a small, plastic reservoir which is connected to a water hose. Each sample was poured into the water-filled reservoir while incoming water from the hose agitated and swirled the sediment, causing the organic fraction to float off into a fine-meshed geologic sieve (Sieve No. 60).

The residue from each sample was then air dried and examined under a binocular dissecting microscope at 20x magnification. The charred plant macrofossils were removed and identified using seed manuals (Albee 1980; Martin and Barkley 1961) and the seed reference collection at Western Wyoming College.

To avoid faulty interpretations due to contamination from the modern seed rain, only charred plant remains are considered prehistoric in this analysis. Seeds are produced in enormous quantities and are naturally deposited by such means as root holes, drying cracks, downwashing, and burrowing organisms (Keepax 1977). Generally, under normal environmental conditions, these uncharred seeds will decompose in less than a century after deposition (Minnis 1981). For this analysis, the term "seed" is used in the common sense and includes fruits such as achenes.

RESULTS

The fill samples from 31 of the 35 features from the Buffalo Hump site examined during this analysis yielded charred seeds identified to 13 taxa (Table 1). A total of 10,752 charred seeds was recovered, of which 8021, or 75%, are goosefoot (Chenopodium sp.). Features from

Table 1. Distribution of charred plant macrofossils recovered from the Buffalo Hump site.

Feature No.	Feature Type	A.S.S. No.	Volume (L)	Component 1					Component 2					Total
4	Large oxidized basin	104, 109, 115	11.0	-	2	-	12	-	-	-	-	-	-	14
3	Small unoxidized bell	84	8.5	-	-	-	-	-	-	-	-	-	-	0
7	Medium oxidized basin	130, 131	10.0	-	8	-	-	-	-	-	-	-	-	8
14	Medium oxidized basin	204	5.0	-	81	-	-	4	-	1	-	-	1	87
15	Midden	208	5.0	-	79	-	2	3	-	-	-	-	-	84
16	Structure	250, 251, 311, 312	15.0	-	1063	113	65	2	5	1	-	-	-	1249
21	Small unoxidized basin	213, 214	5.0	-	163	9	5	1	-	1	-	-	4	183
23	Large oxidized bell	257, 384	20.0	-	14	-	-	-	1	-	-	-	1	16
24	Large oxidized bell	378, 379	17.5	135	4241	190	1459	27	81	-	54	-	27	6214
25	Small unoxidized basin	380, 381	2.5	15	262	46	-	-	1	-	-	-	-	324
26	Medium unoxidized basin	290	4.5	-	5	-	-	7	-	-	-	-	-	12
27	Structure	299, 406, 407	3.0	3	277	32	28	-	8	-	-	-	-	348

Table 1. Continued.

Feature No.	Feature Type	A.S.S. No.	Volume (L)	Component 2 (Continued)													Total
33	Small unoxidized bell	386, 387	5.0	7	486	65	30	-	1	-	8	0	0	0	0	0	597
34	Small unoxidized basin	643, 644	4.0	-	-	-	-	-	-	-	-	2	4	-	2	-	8
36	Medium unoxidized basin	693, 746	7.5	-	1	-	-	2	5	-	-	4	2	-	1	-	15
37	Small oxidized basin	818, 819	4.0	-	2	-	-	-	-	-	-	3	2	-	8	-	15
38	Irregular shallow	823, 825	2.0	-	-	-	-	-	-	-	-	-	-	-	-	2	2
39	Irregular shallow	824, 826	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total				160	6682	455	1587	11	33	14	100	9	65	-	11	-	35 9162
Component 3																	
2	Small unoxidized basin	68, 69, 70 71	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	0
6	Small unoxidized basin	112	5.0	-	39	2	-	-	-	-	-	-	-	-	-	-	41
8	Structure	187, 188, 189, 190, 191	15.0	-	291	39	1	-	1	1	2	2	-	1	-	-	342
9	Medium oxidized basin	148	15.0	-	-	-	-	1	-	-	-	-	-	-	-	-	1
12	Large oxidized bell	175, 176	12.5	-	2	-	-	1	-	-	-	1	-	-	-	-	4
13	Irregular shallow	185	15.0	-	1	-	-	-	-	-	-	-	-	-	-	1	2

Table 1. Concluded.

Feature No.	Feature Type	A.S.S. No.	Volume (L)	Component 3 (Continued)													Total
17	Large oxidized bell	228, 234, 235	10.0	-	826	117	33	-	3	-	5	-	2	-	-	-	986
18	Irregular shallow	238, 239	5.0	-	35	-	3	-	-	-	-	-	1	-	-	-	39
19	Irregular shallow basin	240, 241	5.0	-	18	2	2	-	-	-	-	-	-	-	-	-	22
20	Small unoxidized basin	242, 243	2.0	-	30	3	-	-	-	-	-	-	-	-	-	-	34
28	Medium unoxidized basin	316	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	0
29	Medium oxidized basin	327, 393	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	3
30	Medium oxidized bell	328, 394	12.5	-	3	-	-	-	-	-	-	-	-	-	-	-	3
35	Medium unoxidized basin	539	5.0	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Total				-	1245	163	39	2	4	1	7	3	3	1	1	-	1478
41	Medium oxidized bell	882	2.5	-	Monitor												
43	Midden	883	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	1
44	Small oxidized basin	884	5.0	-	82	-	-	3	-	-	-	-	-	-	-	-	85
Total				-	10	-	-	-	-	-	-	-	-	-	1	1	12
Grand Total				-	92	-	-	3	-	-	-	-	-	-	1	-	98
				160	8021	618	1626	28	37	15	107	12	68	1	13	1	45 10752

Components 1, 2, and 3 and the monitor produced some plant macrofossils. The only feature from Component 1 was Feature 4, a large, oxidized basin with an age of 1870 years ago. The 12 beeweed (Cleome sp.) and two goosefoot seeds found in this feature contrast with the results from most of the other features at the site where goosefoot seeds dominated.

For Component 2, dating to 1480 years ago, 15 of the 17 pit features examined yielded some charred seeds. The majority of the seeds were recovered from within the structures, Features 16 and 27, or from associated features. Interior features associated with Structure Feature 16 that contained large quantities of seeds included Features 24, 25, and 33. Feature 24, a large, oxidized, bell-shaped pit, had the highest density of charred seeds for the component. The plant macrofossil assemblage from these features is dominated by goosefoot seeds, and the second most common types are monolepis (Monolepis nuttalliana) and mustard (Cruciferae family). Other identified taxa, occurring in smaller quantities, are saltbush (Atriplex sp.), sagebrush (Artemisia sp.), sedge (Carex sp.), grass (Gramineae family), and sunflower (Helianthus sp.).

Features 15 and 21, located just outside and to the southeast of Structure Feature 16, also produced fairly large numbers of charred seeds, but in smaller quantities than the interior features. Again, goosefoot seeds dominate the collection with only a few belonging to other taxa. A large, oxidized, bell-shaped pit (Feature 23) situated along the southern edge of the structure yielded only a few seeds which are mostly goosefoot. Only 12 seeds were recovered from Feature 26, a medium, unoxidized basin located about a meter north of the structure. Slightly more than half are beeweed, and the others are goosefoot. The assemblage from the exterior features associated with the other structure, Feature 27, follows a similar pattern. Feature 14, a medium, oxidized basin situated just to the southeast of the structure, produced mostly goosefoot seeds but in smaller quantities than the structure. Of the two features located northwest of the structure, Feature 7 had only eight seeds and Feature 3 lacked plant macrofossils.

The other examined features from Component 2 were in areas removed from the structures and were characterized by a scarcity of charred seeds. Features 34, 36, 37, and 38 yielded only a few seeds, and Feature 39 lacked plant macrofossils. Instead of goosefoot, these seeds are mostly of taxa such as Indian ricegrass (Oryzopsis hymenoides), other grasses, or sticky phacelia (Phacelia ivesiana).

Twelve of the 14 pit features examined for Component 3 produced some charred seeds. Radiocarbon age estimates for the component average about 1200 years ago. As in Component 2, most of the seeds were recovered from within the structure, Feature 8, and associated features. Feature 17, a large, oxidized, bell-shaped pit within the structure, contained the highest density of seeds for the component. The next highest concentration of seeds came from the fill of the structure. The remaining interior pits, Features 18, 19, and 20, had lower frequencies but were still higher than the other features belonging to the component. Goosefoot seeds dominate the assemblage from these associated features, and monolepis is the second most common taxon. A single juniper (Juniperus osteosperma) seed fragment also was recovered from the fill of the structure.

Among the features in areas removed from the structure, Features 28, 29, 30, and 35, which form a group, had only seven seeds among them.

Most of these are unknown fragments. The other group of pits, Features 9, 12, and 13, also yielded only seven seeds. These seeds were identified to beeweed, Indian ricegrass, and goosefoot.

In addition to the features encountered in the main excavation block, three features found during the pipeline trench monitor were examined for plant macrofossils. Of these, Feature 43, a midden, yielded the most with the majority being goosefoot. Also recovered from this feature were a pricklypear (Opuntia polyacantha) seed fragment and a phacelia seed. Feature 41, a medium, oxidized, bell-shaped pit, had only an unidentifiable seed fragment. Because these features were found outside the excavation block, they could not be assigned to one of the components for the site.

DESCRIPTION OF TAXA AND ETHNOGRAPHIC USES

The 13 identified taxa are described and their ethnographic uses are discussed below. Except for juniper, all of the plants represented in the macrofossil assemblage either were observed in the vicinity of the Buffalo Hump site or probably occurred in the area at the time of occupation. Many are weedy species or "camp followers" that invade recently disturbed environments and may have been quite common on the site in the past. Most of these species are mentioned in the ethnographic or ethnobotanic literature as having been used as food by Indian groups of the Intermountain West. The following ethnographic descriptions will provide clues for interpretations on their prehistoric use at the site.

Saltbush

Saltbush (Atriplex sp.) seeds were recovered from features associated with the two structures, Features 16 and 27, belonging to Component 2. Various species of Atriplex cover wide expanses of the Wyoming Basin. Among those observed in the vicinity of the Buffalo Hump site are Nuttall's saltbush (A. gardneri), shadscale (A. confertifolia), and spiny hopsage (A. spinosa). The charred seeds identified from the Buffalo Hump site may belong to spiny hopsage, a species in which the fruits can be easily removed from the bracts.

Ethnographically, seeds from several species of Atriplex were gathered by the Indians of Utah, Arizona, and California and ground into flour for bread and mush (Palmer 1878). These seeds, along with those from other taxa in the Chenopodiaceae family, formed one of the most important sources of seed food for the Gosiute Indians of Utah (Chamberlin 1911). Archaeological evidence for the use of saltbush in the Intermountain West comes from seeds found in flotation samples at Sudden Shelter located on the northern Colorado Plateau (Coulam and Barnett 1980). In southwest Wyoming, charred Atriplex seeds were part of the plant macrofossil assemblage from 48CR3495 in the Red Desert (Sender et al. 1982) and 48SW1242 (Smith 1986a) and the Taliaferro site (Smith 1986b) in the Green River Basin.

Goosefoot

Charred goosefoot (Chenopodium sp.) seeds dominate the plant macrofossil assemblage from features associated with the structures from Components 2 and 3. Seeds of this taxon are by far the most common. Goosefoot is a weedy annual which invades cultivated places and waste areas and can produce up to 100,000 seeds per plant (Herron 1952). At present, the plant is rare in the natural vegetation of the site vicinity, but it was probably was common in the disturbed areas at the time of occupation.

Chenopodium was an important food plant throughout North America during prehistoric times as attested by their common occurrence in archaeological assemblages. For example, seeds belonging to the Chenopodiaceae and Amaranthaceae families dominate the plant macrofossil collection from Sudden Shelter located on the Colorado Plateau (Coulam and Barnett 1980). Goosefoot seeds are also present in prehistoric coprolites from sites such as Hogup Cave and Danger Cave in the eastern Great Basin (Fry 1976). Evidence for their use on the Northern Plains comes from the Ross Site in Alberta, where a large cache of these seeds was found (Johnson 1962). In southwest Wyoming, Chenopodium is the most common taxon at sites that contain charred seeds (Smith 1986b).

Additionally, C. berlandieri and C. bushianum, two very similar species which some authors combine into one (cf. Asch and Asch 1985), appear to have been domesticated in some areas of the Southeast and Midwest as early as 4000 years ago (Cowan 1985). Evidence for domestication is based on morphological differences in the thickness of the outer seed coat of seeds from archaeological sites compared with those of modern wild and domesticated species (Asch and Asch 1985; Smith 1984).

The use of goosefoot seeds by historic Indian groups throughout the Intermountain West is noted in numerous ethnobotanic and ethnographic reports (Yanovsky 1936). Palmer (1871) mentions that many tribes in New Mexico, Arizona, California, and Utah gathered the seeds in large numbers, which were then ground into flour and mush. Goosefoot seeds are among the species collected by J. W. Powell from the Kai-vav-its of northern Arizona in 1872 (Bye 1972). In the Ethno-botany of the Gosiute Indians of Utah, Chamberlin (1911) notes that members of the Chenopodiaceae family, especially goosefoot, furnished a great quantity of nutritious seeds which formed the chief source of food. They also were important to the Nevada Shoshoni (Steward 1938). The Zuni maintain that the seeds of Chenopodium, together with those of Artemisia wrightii, were among their most important foods in the past (Castetter 1935). According to Blankinship (1905), the wide distribution and abundance of goosefoot in Montana are the result, in part, of Indians gathering the seeds for food. Goosefoot seeds also were used by the Indians of the South Dakota region (Rogers 1980). In addition to their seeds, young plants and leaves were boiled as "greens" alone or with other food (Gilmore 1919; Palmer 1871; Rogers 1980; Steward 1938).

Monolepis

Monolepis (Monolepis nuttalliana) seeds were recovered in small quantities from most features associated with the structures in Components 2 and 3. Monolepis is a low-branching annual that is found

on disturbed, alkaline, or dry soils (Alley and Lee 1969) and, along with Atriplex and Chenopodium, is a member of the Chenopodiaceae family.

In the ethnobotanic literature, Chamberlin (1911) notes that the seeds were used as food in the same manner as those from goosefoot by the Gosiute Indians of Utah. The Pima Indians of Arizona would boil the seeds and then partially dry, parch, grind, and eat them as pinole (Russell 1908). The roots also were used as food by the Pima Indians. Archaeologically, charred monolepis seeds are part of the plant macrofossil collections from 48SW1091 (O'Brien et al. 1982), 48SW1242 (Smith 1986a), and the Taliaferro site (Smith 1986b), located in the Wyoming Basin, southwest Wyoming.

Cruciferae

Seeds of the mustard (Cruciferae) family were found in several features associated with the structures in Components 2 and 3. They are most common in Features 17 and 24, the large, oxidized, bell-shaped pits located within the structures (Features 8 and 16, respectively). These seeds may belong to flaxleaf hedge mustard (Schoenocrambe linifolia), a forb present on the clayey flats in the valley below the Buffalo Hump site. Other taxa in the Cruciferae family observed at the site include silvery bladderpod (Lesquerella ludoviciana), Holboell rockcress (Arabis holboellii), and wallflower (Erysimum capitatum). The seeds may also be from a peppergrass (Lepidium sp.), another common member of the Cruciferae family in the Wyoming Basin.

Many ethnobotanic and ethnographic reports mention the use of seeds from species in the Cruciferae family by Indian groups of the western United States (Yanovsky 1936). The seeds from Lepidium spp. and Schoenocrambe spp. (formerly Sisymbrium spp.) were ground with other seeds to impart flavor in bread and mush (Palmer 1878). They also were often used unmixed in soups. For the Gosiute Indians of Utah, the most important Cruciferae furnishing edible seeds was hedge mustard (Schoenocrambe or Sisymbrium spp.); however, several taxa in this family were lumped under the same Gosiute name (Chamberlin 1911). The Gosiute made a favored mush from these seeds as well as grinding and mixing them with snow in winter to form a kind of confection.

Seeds belonging to the Cruciferae family are common in plant macrofossil assemblages from archaeological sites. Cowboy Cave (Barnett and Coulam 1980) and Sudden Shelter (Coulam and Barnett 1980) on the northern Colorado Plateau contained peppergrass seeds. They also were recovered from prehistoric coprolites from Utah sites (Fry 1976). In southwest Wyoming, charred Cruciferae seeds were found in features from the Austin Wash site, 48UT445 (Schroedl 1985), 48SU873 (Smith 1986c), and the Taliaferro site (Smith 1986b).

Beeweed

Beeweed (Cleome sp.) seeds occur in small quantities in the three components examined for plant macrofossils. They are the most common taxon in Feature 4, a large, oxidized basin from Component 1. A few features that were mostly in areas removed from the structures in Components 2 and 3 also contained a few. Beeweed is an annual plant with stems up to a meter tall. It flowers in July and August and grows in waste places or open, sandy areas. Though not observed in the

vicinity of the Buffalo Hump site, it occurs throughout southwest Wyoming and probably grew on the disturbed site area at the time of occupation.

Ethnographically, leaves and flowers were commonly used as a potherb (Yanovsky 1936). In the southwest, beeweed was one of the most important native plants (Castetter 1935). It is one of the wild plants listed by Whiting (1939) that the Hopi encouraged and allowed to grow and seed in their fields. The plant has a distinctive unpleasant odor which disappears with cooking (Standley 1912). The seeds also are gathered and eaten (Elmore 1944). The Indians of Isleta in New Mexico used the seeds of Rocky Mountain beeweed (C. serrulata) as a meal for baking bread (Castetter 1935). Archaeological evidence of its use in southwest Wyoming comes from charred seeds recovered in flotation samples of feature fill at 48CR3495 in the Red Desert (Sender et al. 1982) and the Taliaferro site in the Green River Basin (Smith 1986b).

Sagebrush

A few charred seeds identified as sagebrush (Artemisia sp.) were recovered from features belonging to Components 2 and 3. Most were found in Features 17 and 24, the large, oxidized, bell-shaped pits located within structures (Features 8 and 16, respectively). Big sagebrush (A. tridentata) is the dominant shrub in the area of the Buffalo Hump site and covers wide expanses of southwest Wyoming. Other species also occur in the area.

The seeds of some species of Artemisia were gathered and ground into a mush by Indian groups of the Intermountain West (Chamberlin 1911; Palmer 1878). The seeds are oily and nutritious and were extensively gathered as food by the Gosiute Indians. The Zuni claimed that the seeds of A. wrightii, together with those of Chenopodium, were among their most important foods (Castetter 1935). Indians of the South Dakota region also ate the seeds raw or dried and pounded them into meal (Rogers 1980). Some Indian groups, however, used sagebrush seeds only as an emergency food because of their bitter taste (Steward 1933). The leaves were made into a strong tea, which was used for headaches, colds, and worms (Palmer 1878). Sagebrush also provided fuel in treeless areas. Archaeologically, Artemisia seeds were part of the plant macrofossil assemblage from Sudden Shelter on the northern Colorado Plateau (Coulam and Barnett 1980). A sagebrush seed was recovered from a feature at the Taliaferro site (Smith 1986b).

Sunflower

Sunflower (Helianthus sp.) seeds, or actually, achenes were present in small quantities in a few features associated with the structures belonging to Components 2 and 3. Most were found in the fill from the structures, Features 8, 16, and 27. The most abundant wild species is the common sunflower (H. annuus) which grows throughout the western United States in a variety of habitats including waste areas and open fields. It blooms from July to September. Although not observed in the vicinity of the Buffalo Hump site, it presently lines some of the roads in southwest Wyoming.

Many Indian groups throughout the western United States extensively gathered the achenes of wild sunflowers for food (Heiser 1951). The

Gosiute prized the seeds highly as a source of food and oil (Chamberlin 1911). Using paddles, the Indians beat the ripe seeds out of the heads into baskets using paddles. The seeds were then parched and ground into a meal or flour; made into thin, gray cakes; and baked in hot ashes (Palmer 1878). The seeds were also eaten raw (Palmer 1871). The Shoshoni of Idaho and Wyoming made bread from sunflowers and goosefoot seeds mixed with berries and wild cherries as noted by Gass (1807) during the Lewis and Clark expedition. The sunflower also was used widely in medicine and in ceremonies (Heiser 1951).

In addition to its wild form in the western United States, the sunflower was cultivated and domesticated during prehistoric times in the eastern United States (Heiser 1985). Heiser believes that the common sunflower moved from the West to the East as a weedy camp follower and then was developed into domesticated forms. Because sunflowers are a weedy, pioneer species which does best in recently disturbed habitats, its distribution in the West may also have been the result of human activities and encouragement. Blankinship (1905) states that its wide distribution throughout Montana was probably largely due to the Indians.

Archaeological evidence for its use in the Intermountain West comes from achenes found in flotation samples from Sudden Shelter on the northern Colorado Plateau (Coulam and Barnett 1980). A few sunflower achenes were identified from the plant material from Castle Park in Dinosaur National Monument (Jones 1948). In southwest Wyoming, charred achenes were recovered from a feature at 48UT779 (Schroedl 1985) and two Late Prehistoric components at the Taliaferro site (Smith 1986b).

Sedge

Sedge (Carex sp.) seeds occurred in most features associated with the structures belonging to Components 2 and 3. The majority were found in Feature 24, a large, oxidized, bell-shaped pit associated with the structure, Feature 16. These sedge seeds probably were obtained from along Bush Creek located in the valley just below the Buffalo Hump site. The seeds may be from Nebraska sedge (C. nebraskensis), a common species along the waterways in the region. This sedge grows in moist to wet places, often in alkaline soils, and flowers from May to August. Ethnographically the leaves of some species were woven into mats, and the succulent, young stems were used as food (Blankinship 1905; Chamberlin 1911; Coville 1897). Charred sedge seeds were found in features from archaeological sites such as Cowboy Cave (Barnett and Coulam 1980) and Sudden Shelter (Coulam and Barnett 1980) on the northern Colorado Plateau. In the Green River Basin they were recovered from features at the Taliaferro site (Smith 1986b).

Indian Ricegrass

Charred Indian ricegrass (Oryzopsis hymenoides) seeds are part of the plant macrofossil assemblages from Components 2 and 3. For Component 2, a few of these seeds were found in features located in areas removed from the structures. In Component 3, Feature 8, the structure, and Feature 12, a large, oxidized, bell-shaped pit not associated with the structure, also contained one or two Indian ricegrass seeds. Indian ricegrass occurs on the open ridge top of the

Buffalo Hump site in association with sagebrush. It flowers in May to July.

Indian groups throughout the western United States would gather large quantities of these small, black, nutritious seeds which were parched in trays with hot coals and ground into flour for mush or bread (Blankinship 1905; Chamberlin 1911; Palmer 1871). Steward (1938) notes that the amount collected was limited due to the short harvest season of only a few weeks. Indian ricegrass seeds were recovered from archaeological sites such as Sudden Shelter (Coulam and Barnett 1980) and from prehistoric coprolites (Fry 1976). They were also present in features from the Taliaferro site (Smith 1986b), 48UT445 (Schroedl 1985), 48SW2429 (Nelson 1982), 48CR3472, and 48CR3495 (Sender et al. 1982) in southwest Wyoming.

Gramineae

Unidentifiable grass (Gramineae family) seeds were recovered in small quantities in features from Components 2 and 3. The majority were from Component 2 where seven features had some. These seeds may be from dropseed (Sporobolus sp.), a common grass in alkaline to slightly saline, sandy soil, which flowers from June through September. The seeds of this grass were an important food for the Indians of the Intermountain West (Palmer 1878). They were first parched and then ground into flour for bread or mush. Archaeologically, Sporobolus seeds have been identified from Sudden Shelter on the northern Colorado Plateau (Coulam and Barnett 1980).

Juniper

A Utah juniper (Juniperus osteosperma) seed fragment came from the fill of Feature 8, the structure from Component 3. Additionally, an uncharred juniper seed bead was found in Feature 36, a medium, unoxidized basin belonging to Component 2. At present, junipers do not grow in the vicinity of the Buffalo Hump site but occur several kilometers away on the breaks and low hills that surround the Great Divide Basin.

Ethnographically, the fruit of several species of juniper was collected and used by Indian groups of western North America (Yanovsky 1936). The Utes ate the fruits of the Utah juniper (J. osteosperma) raw or made them into a bread (Palmer 1878). For bread, they were dried, ground into flour, mixed with water, kneaded into a hard mass, and dried in the sun (Palmer 1871). Chamberlin (1911) states that the Gosiute boiled and ate the berries in the fall and winter. Additionally, juniper wood was used in the construction of winter lodges, and the bark provided a lining and cover for pits in which dried fruits and seeds were stored. The recovery of charred juniper seed fragments from 48SW369 (Van Ness 1982) and the Maxon Ranch site (Smith 1986d) in southwest Wyoming gives additional evidence for its prehistoric use.

Phacelia

Charred sticky phacelia (Phacelia ivesiana) seeds were recovered from three features in Component 2 and one feature from Component 3. All were from features located in areas removed from the structures. Sticky

phacelia is a small forb that grows on dry, sandy plains and hills, often in association with sagebrush. Though unobserved during the excavations, it probably occurs on the ridge of the Buffalo Hump site. The ethnobotanic literature records that other species of phacelia were used as greens in California (Yanovsky 1936). The Kawaiisu of California collected and steamed-cooked the stems and leaves in the spring (Zigmond 1981). The literature lacks any mention of the use of the seeds or of the particular species identified from the Buffalo Hump site.

Pricklypear

One charred pricklypear (Opuntia polyacantha) seed fragment was found in Feature 44, a small, oxidized basin encountered during the pipeline construction monitor. Pricklypear is a sprawling cactus with jointed, flattened, fleshy stems that blooms from April to July. It is common in sandy areas throughout southwest Wyoming.

Ethnographically, pricklypear was an important food plant for the Indian groups throughout the area (Yanovsky 1936). The Indians of the Plains ate the young joints and the red fruit (Blankinship 1905). The joints usually were boiled, which allowed for the easy removal of the skin and spines. Some Indian groups roasted the stems in hot ashes to remove the thorns (Chamberlin 1911; Palmer 1871). The fruits, often called tunas, were collected in great quantities and eaten raw or dried for winter use (Palmer 1871). The dried fruits were cooked with meat. In addition to the fruit and stems, the seeds were parched, pulverized, and made into an excellent gruel (Harvard 1895). Charred pricklypear seeds were part of the plant macrofossil collection from 48CR3495 in the Red Desert of southwest Wyoming (Sender et al. 1982).

Unknown

Unidentifiable charred seeds were recovered from a few features belonging to Components 2 and 3. Most were too fragmentary for identification.

TYPE AND SEASON OF ACTIVITIES REPRESENTED

The prehistoric inhabitants at the Buffalo Hump site probably engaged intensively in the collection and processing of a wide variety of seed foods, as evidenced by the recovery of thousands of charred seeds representing 13 taxa. As shown in the description for each taxon, most, especially those of weedy species, provided seeds that were a major source of food for the ethnographic groups of the Intermountain West.

Ethnographic descriptions of the seed gathering and processing techniques provide clues to the methods employed during prehistoric times at the Buffalo Hump site. These accounts usually mention that the women gathered the seeds of various species into large conical baskets. A twined basketry seed beater was used to sweep the seeds into this basket, which often was suspended from the gatherer's forehead by broad straps. The gathered material was carried to the encampment and piled

upon the ground for processing. The seeds were separated from the chaff and other waste products by threshing and winnowing. The threshing was accomplished by placing the seeds on the ground and beating them with sticks and paddles. The threshed material was thrown into the air to allow the wind to blow away the lighter, unwanted parts while the seeds fell onto a skin. Often, the seeds were winnowed and parched with hot coals in basket trays and then ground on a metate (Chamberlin 1911; Kelly 1932; Steward 1941). This pattern of collecting and processing seeds was fairly uniform throughout the western United States during ethnographic times (Steward 1938, 1941).

During his explorations of the Colorado River in the late 1860s and early 1870s, Powell observed the Kaibab Paiute of northern Arizona and southern Utah processing seeds of several species and gives this interesting and poetic description:

They roast these curiously; they put the seeds, with a quantity of red hot coals, into a willow tray, and, by rapidly and dexterously shaking and tossing them, keep the coals aglow, and the seeds and tray from burning. As if by magic, so skilled are the crones in this work, they roll the seeds to one side of the tray, as they are roasted, and the coals to the other. Then they grind the seeds into a fine flour, and make it into cakes and mush. It is a merry sight, sometimes, to see the women grinding at the mill. For a mill, they use a large flat rock, lying on the ground, and another small cylindrical one in their hands. They sit prone on the ground, hold the large flat rock between the feet and legs, then fill their laps with seeds, making a hopper to the mill with their dusky legs, and grind by pushing the seeds across the larger rock, where it drops into a tray. I have seen a group of women grinding together, keeping time to a chant, or gossiping and chatting, while the younger lassies would jest and chatter, and make the pine woods merry with their laughter [Powell 1875:126-127].

The early explorers of the Intermountain West noted that seeds often were left in piles about the Indian encampments during the processing. While exploring on the western side of Promontory Point, Utah, in October 1849 Stansbury "came to a brackish spring, where there had been a camp of Indians the night before. . . . A quantity of some species of seeds they had been beating out lay in small heaps around" (1852:103). Fremont, while traveling up the Bear River in September 1843 also found "a small encampment of two families of Snake Indians. . . . They had piles of seeds, of three different kinds, spread out upon pieces of buffalo robe" (1845:159).

These historic accounts also indicate that seeds from several species were processed together, which is consistent with the plant macrofossil assemblage from the Buffalo Hump site where several different taxa were identified from the same feature. Ethnographically, several kinds of seeds were mixed and ground together and made into cakes (Palmer 1871). Sunflower seeds were mixed with those of goosefoot and others as noted for the Shoshoni by Gass (1807:125, 128) during the Lewis and Clark expedition. The seeds of the Cruciferae family were ground with others to impart flavor for the bread or mush (Palmer 1878).

Following the processing and grinding, the resulting meal was ready for storage or immediate use. For storage, the material was placed in a groundhog skin, sage-bark bag, or basket and buried in pits (Chamberlin 1911; Steward 1941). The Nevada Shoshoni preferred pits to above ground caches because pits could be concealed from robbers. Often the pits were partitioned for each type of seed and lined with bark, brush, or grass. The Kaibab of northern Arizona and southern Utah stored surplus products in bark-lined pits dug into caves or rock shelters (Kelly 1964). These caches usually were covered with layers of bark, poles, earth, and stone. Seeds often were stored as gathered and were not parched or ground until needed (Chamberlin 1911; Kelly 1932). These storage activities need to be considered when making interpretations on the season of the occupation of a site based on the phenology of the plants represented by the recovered macrofossils.

The Indians of the Intermountain West prepared the ground flour as mush or bread (Chamberlin 1911; Palmer 1871, 1878). To make the mush, the seed meal was mixed with water and boiled in a basket using hot rocks (Kelly 1932). The stones were heated in a fire and then added to the contents of the basket "producing a mess mixed with soot, ashes, and dirt" (Wyeth 1851:211). The ground substance was also baked in hot ashes to produce a bread. As noted by Palmer, flour made from the gray goosefoot seeds "imparts to the bread a very dirty look, and when baked in ashes it is not improved in appearance" (1871:419). Cakes made from pounded goosefoot and sunflower seeds mixed with hawthorns, chokecherries, and serviceberries were dried in the sun for future consumption (Gass 1807; Palmer 1871; Wyeth 1851).

Most likely, some of the activities mentioned in the above ethnographic descriptions took place at the Buffalo Hump site during the time of occupation. Seeds of several species probably were collected in areas such as the clayey flats in the valley below the site and then brought back for processing. Because the majority of the charred seeds were recovered from the fill of the structures or associated features, these areas appear to have been the loci of intensive seed processing activities. This would have provided a wind-free area in which to pile, thresh, winnow, parch, and grind the seeds. A similar concentration of charred seeds was recovered from the fill of a large basin at the Taliaferro site which also probably was covered by a temporary structure (Smith 1986b).

As noted in the ethnographic descriptions, the gathering and processing of seeds precludes the direct use of fire hearths except for obtaining coals for parching or, perhaps, for baking of bread in hot ashes. Charred seeds, however, could be accidentally incorporated into the features during any stage of the processing. Seeds probably were scattered in the areas within and around the structures during the various activities, especially because the seeds would have been left in piles. The high densities of seeds present in Features 17 and 24, the large, oxidized, bell-shaped pits occurring within two of the structures, may represent the baking of bread.

In addition to the processing of the seeds, some of the recovered plant macrofossils may have become incorporated into the features due to the natural prehistoric seed rain or by the indirect use of the plant containing the seed (Minnis 1981). Plants growing on the site at the time of occupation could have produced seeds that were accidentally charred and preserved in the features. Greenhouse et al. (1981)

encountered this problem in interpreting the charred plant macrofossil record during their analysis of flotation samples from a modern cholla roasting pit in Arizona. They found charred sweepweed (Suaeda torreyana) seeds in the samples which they felt were due to the use of the plant to cover the buds while roasting or as the result of the seeds being in the soil near the pit.

Some of the few seeds recovered from the features located in areas removed from the structures may be from the prehistoric natural seed rain. This is especially true of phacelia; seeds of this taxon, which were recovered only from these features, lack known ethnographic economic uses. The charred grass seeds may have become incorporated into these outlying features as the result of the inhabitants using grass with seeds to line roasting pits or from other such activities. Overall, most of the intensive seed processing at the Buffalo Hump site appears to have taken place in the sheltered areas.

Most of the seeds recovered during this analysis would have been available in the late summer and early fall, which would indicate an occupation for the site at least during this time of year. The late summer and early fall was a time of plenty when the Indian groups of the Intermountain West intensively collected stores for winter use (Kelly 1932, 1964; Lowie 1924). The gathering of seeds at this time of year by historic groups is evident from the early exploration reports. While traveling through the valley of Ogden Creek in late August 1849, Stansbury came upon a group of eight or ten Indian women and girls, "each with a basket on her back, gathering grass-seeds for their winter's provision. They were of the class of 'root diggers,' or as the guides called them, 'snake diggers'." (1852:82). As mentioned above, Fremont (1845:159) and Stansbury (1852:103) observed in September and October Indian camps with piles of seeds that apparently were being threshed and winnowed.

In summary, the occupants of the Buffalo Hump site most likely intensively processed seeds of a variety of species in the late summer or early fall for winter stores. These activities were centered within the wind-free sheltered areas (pit structures) and included threshing, winnowing, parching, grinding, and, perhaps, baking of the resulting flour. The areas removed from the structures were probably the loci of other subsistence endeavors.

COMPARISONS WITH OTHER MACROFOSSIL ASSEMBLAGES

Over the past few years, plant macrofossil analyses of fill from many feature types representing most temporal periods in southwest Wyoming have begun to yield enough data for comparisons. Although the relative importance of each taxon in their diet cannot be made from the actual number of seeds of each type recovered, comparisons can provide at least some clues to the kinds of seeds used by prehistoric peoples during each period. Table 2 lists by chronological period the charred seeds recovered from selected sites in the Wyoming Basin of southwest Wyoming. It also includes the number of features examined, the number with seeds for each site or component, and the radiocarbon ages.

As is clearly shown in Table 2, the majority of the features yielding charred plant macrofossils belong to the Late Prehistoric period dating between 900 and 1600 years ago. Of the 67 early Archaic

period features examined, only 11, or 16%, contained charred seeds. Most of these assemblages had only a few seeds per site or component. One exception is Component I at the Maxon Ranch site where four features had numerous chokecherry (Prunus virginiana) seed fragments (Smith 1986d). The results from the Middle Archaic period, dating from 3000 to 4800 years ago, are even more scanty than the previous period. Only two, or 9%, of the 21 features examined, produced a total of three charred seeds or fragments. For the Late Archaic period with an age between 1800 and 3000 years B.P., three, or 15%, of the 19 features examined had charred seeds. The three features with macrofossils are from Component III at the Taliaferro site (Smith 1986b).

In contrast to the Archaic periods, 63, or 72%, of the 87 examined pit features yielded plant macrofossils. At least one feature from each component or site of this age listed in Table 2 contained some charred seeds. Thousands of seeds representing a wide variety of taxa were recovered from some features at such sites as the Taliaferro site (Smith 1986b). Overwhelmingly, goosefoot (Chenopodium sp.) is the dominant taxon in these assemblages. Among the other identified species are beeweed (Cleome sp.), sunflower (Helianthus sp.), monolepis (Monolepis nuttalliana), Indian ricegrass (Oryzopsis hymenoides), and ones in the mustard (Cruciferae) family.

The paucity of charred plant macrofossils from the Archaic periods in southwest Wyoming is probably not a function of preservation because most features from the period are still relatively intact with charcoal occurring in most. Though the sample of Archaic period features with plant macrofossils will most likely increase with further research, there appears to be a dramatic change to a greater reliance on seed foods by the Late Prehistoric period. The results of the plant macrofossil analysis from the Buffalo Hump site are consistent with this pattern for the Late Prehistoric period. Thirty of the 34 examined Late Prehistoric features produced thousands of charred seeds of taxa similar to those mentioned above. The Buffalo Hump site, the Taliaferro site, and others most likely represent loci of extensive seed processing during this period.

Most of the taxa identified in these Late Prehistoric plant macrofossil collections are pioneer, weedy species that thrive in recently disturbed areas. All were important in the diet of the ethnographic groups of the western United States. The seeds from these taxa are available in the late summer and fall around August and September, which corresponds to the time of year noted in the ethnographic and historic reports when seeds were gathered for winter stores. This suggests that the Green River and Great Divide basins, especially at localities such as the Buffalo Hump and Taliaferro sites, were inhabited at least during the late summer for the procurement of seeds for the winter.

In contrast, the Maxon Ranch site, located in the foothills above the basins, lacked charred seeds from weedy species in features belonging to the Late Prehistoric Component IV. Only a rose (Rosa sp.) and a juniper (Juniperus scopulorum) seed fragment were recovered from two of the eleven examined features (Smith 1986d). This site probably was occupied during periods of the year other than the late summer, when sites in the lower basins were in use.

The two Early Archaic components at the Maxon Ranch site, while producing evidence of housepits, also lacked plant remains from weedy

Table 2. Charred seeds recovered from selected sites by chronological period in the Wyoming Basin, southwest Wyoming.

Site	Component (Occupation Layer)	Dates (Years B.P.)	No. of Features Examined	No. of Features With Seeds	Seeds Recovered	Reference
Early Archaic Period						
Crooks	Str*. A	4850	3	0	None	Smith 1987a
48SW5215	A	5150	4	1	3 <u>Chenopodium</u>	Smith 1987b
Maxon Ranch	I	6000-6480	16	4	54 <u>Prunus virginiana</u> fragments, 1 <u>Juniperus scopulorum</u> fragment	Smith 1986d
	II	4760-4860	18	2	6 <u>Prunus virginiana</u> fragments, 1 <u>Astragalus</u>	Smith 1986d
Taliaferro	I	5290	2	1	1 <u>Carex</u>	Smith 1986b
48UT199	A	4890	8	0	None	Schroedl 1985
48UT370	-	6480	2	0	None	Schroedl 1985
48CR2220	1	ca. 5000	2	1	4 <u>Chenopodium</u>	Scott 1983
48SW4491	-	5520	7	2	1 <u>Gramineae</u> , 1 <u>Chenopodium</u>	Scott 1983
Sweetwater Creek	1	5130	5	0	None	Scott 1986

Middle Archaic Period						
Crooks	Str*. B, D	4300, 4360	11	1	1 <u>Prunus virginiana</u> fragment, 1 <u>unidentifiable</u>	Smith 1987a
Taliaferro	II	ca. 3000-5000	2	0	None	Smith 1986b
48UT779	1	4670	1	0	None	Schroedl 1985
48SW1091	I	3920	1	1	1 <u>Monolepis nuttalliana</u>	O'Brien et al. 1982
48CR2200	2	4380	2	0	None	Scott 1983

Table 2. Continued.

Site	Component (Occupation Layer)	Dates (Years B.P.)	No. of Features Examined	No. of Features With Seeds	Seeds Recovered	Reference
Middle Archaic Period (Continued)						
Sweetwater Creek	2	4310	3	0	None	Scott 1986
	3	3710	1	0	None	Scott 1986
Late Archaic Period						
48SW1242	2	2170	1	0	None	Smith 1986a
Taliaferro	III	1910-2850	6	3	33 <u>Chenopodium</u> , 1 <u>Cruciferae</u>	Smith 1986b
Maxon Ranch	III	2180	6	0	None	Smith 1986d
48SU873	1	1910	1	0	None	Smith 1986c
48SW1091	II	2070-2740	2	0	None	O'Brien et al. 1982
48FR1468	-	2770	3	0	None	Hoefler and Smith 1987
Late Prehistoric Period						
48SW5215	B	1090	4	2	2 <u>Chenopodium</u>	Smith 1987b
	C	990	4	4	23 <u>Chenopodium</u> , 1 <u>Monolepis</u> <u>nuttalliana</u> , 1 <u>unidentifiable</u>	Smith 1987b
48SW1242	3	1550	5	3	7 <u>Chenopodium</u> , 73 <u>Monolepis</u> <u>nuttalliana</u> , 8 <u>Atriplex</u> , 1 <u>unidentifiable</u>	Smith 1986a
Taliaferro	IV	1500	9	9	1299 <u>Chenopodium</u> , 130 <u>Atriplex</u> 9 <u>Monolepis</u> <u>nuttalliana</u> , 205 <u>Cruciferae</u> , 164 <u>Cleome</u> , 11 <u>Helianthus</u> , 49 <u>Carex</u> , 1 <u>Oryzopsis</u> <u>hymenoides</u> , 42 others	Smith 1986b

Table 2. Continued.

Site	Component (Occupation Layer)	Dates (Years B.P.)	No. of Features Examined	No. of Features With Seeds	Late Prehistoric Period (Continued)	Seeds Recovered	Reference
Taliaferro	V	1310	5	5	151 <u>Chenopodium</u> , 5 <u>Atriplex</u> , 3 <u>Monolepis nuttalliana</u> , 4 <u>Cruciferae</u> , 73 <u>Cleome</u> , 3 <u>Helianthus</u> , 2 <u>Carex</u> , 7 <u>Oryzopsis hymenoides</u> , 19 others		Smith 1986b
	VI	1170	4	3	2344 <u>Chenopodium</u> , 2 <u>Atriplex</u> , 15 <u>Cruciferae</u> , 17 <u>Cleome</u> , 6 <u>Carex</u> , 12 others		Smith 1986b
	VII	960	3	2	32 <u>Chenopodium</u> , 2 <u>Atriplex</u> , 1 <u>Monolepis nuttalliana</u> , 1 <u>Carex</u> , 2 <u>Oryzopsis</u> <u>hymenoides</u> , 5 others		Smith 1986b
Maxon Ranch	IV	1140	11	2	1 <u>Rosa</u> , 1 <u>Juniperus scopulorum</u> , 1 unidentified		Smith 1986d
48SU873	2	1310	2	2	9 <u>Chenopodium</u> , 1 <u>Lepidium</u>		Smith 1986c
Austin Wash	-	1070-1370	10	7	65 <u>Chenopodium</u> , 70 <u>Fragaria</u> , 15 <u>Lepidium</u>		Schroedl 1985
48UT199	A	1260-1460	3	2	2 <u>Chenopodium</u>		Schroedl 1985
48UT779	3	1130	7	6	410 <u>Chenopodium</u> , 39 <u>Fragaria</u> , 2 <u>Helianthus</u> , 10 <u>Salix</u>		Schroedl 1985
48UT445	-	930	1	1	24 <u>Chenopodium</u> , 1 <u>Oryzopsis</u> <u>hymenoides</u> , 1 <u>Lepidium</u> , 9 <u>Salix</u>		Schroedl 1985

Table 2. Concluded.

Site	Component (Occupation Layer)	Dates (Years B.P.)	No. of Features Examined	No. of Features With Seeds	Seeds Recovered	Reference
Late Prehistoric Period (Continued)						
48CR3495	-	790-1650	12	10	1037 <u>Chenopodium</u> , 8 <u>Oryzopsis</u> <u>hymenoides</u> , 31 <u>Atriplex</u> , 7 <u>Cleome</u> , 22 <u>Cruciferae</u> , 1 <u>Atrahagus</u> , 2 <u>Opuntia</u> , 2 others	Sender et al. 1982
48SW1091	III	1150-1340	4	4	10 <u>Chenopodium</u> , 2 <u>Monolepis</u> <u>nuttalliana</u>	O'Brian et al. 1982
48CR2200	3	1650	3	1	1 unidentified	Scott 1983

*Structure

species and contained mostly charred fragments of chokecherry seeds. The chokecherry remains probably represent the winter or spring consumption of dried fruits. This may be true for the Crooks site as well, another Early to Middle Archaic site with housepits located in the uplands above the Great Divide Basin that yielded a charred chokecherry seed fragment (Smith 1987a). Apparently, the uplands around the rim of the basin were important locations for winter habitation.

There is, however, little evidence for late summer seed processing in the basin during the Archaic period. Except for perhaps the one feature with an age of 1870 years ago at the Buffalo Hump site and the Late Archaic component at the Taliaferro site, the few seeds of weedy species recovered from features dating to the Archaic periods probably represent fortuitous introduction due to the natural prehistoric seed rain. The preservation of goosefoot, beeweed, and Cruciferae seeds in the Late Archaic components at the Taliaferro and Buffalo Hump sites may be the result of minor processing activities.

In summary, the analyses of fill from many feature types representing most temporal periods provide evidence of a dramatically greater reliance on seeds from weedy species during the when compared to the earlier Archaic periods. Most likely, during the Late Prehistoric period the Wyoming Basin was occupied, at least in the late summer and early fall, for the procurement and processing of seeds for winter stores. The foothills around the rim of the basin may have been used over the winter and spring months. For the Archaic periods, the gathering and processing of large quantities of seeds of weedy species appears to have been unimportant.

HUMAN INFLUENCE ON PLANT DISTRIBUTIONS

The dramatic increase for the Late Prehistoric period in southwest Wyoming of charred seeds of predominantly weedy species such as goosefoot, sunflower, monolepis, beeweed, and mustards suggests that the prehistoric hunters and gatherers increased the productivity of the plant environment for their benefit. Weedy species are tolerant of a broad range of habitats when there is little competition from other plants. Once ecological succession develops beyond the pioneer stages, they are usually eliminated from the natural vegetation of the locality. Except possibly on disturbed areas, such as playas, these species at present rarely occur as dense stands in the area, and most are seen only along roadways. To produce stands large and dense enough for profitable exploitation of these food plants, areas in the past had to be regularly reduced back to the first stages of plant succession.

Humans acted as the agent, either intentionally or accidentally, for this disturbance. They could have created suitable environments fortuitously during their day to day activities at a site, but unless the prehistoric populations were quite large, this probably disturbed only a minor portion of the required area. Other, more deliberate means may have been employed to ensure an adequate food supply, including burning off the vegetation or the actual sowing of seeds of the desired plants.

In the past, hunters and gatherers throughout North America used fire to revert the vegetation back to the more economically productive, pioneer stages which facilitated gathering, hunting, and travel. Omer

Stewart (1954, 1955a, 1955b), one of the first to promote the idea, mentions numerous examples from the historic and ethnographic literature of Indians intentionally setting fires for their economic benefit. Much of the vegetation observed by the early explorers and first settlers was probably the result of this extensive practice. Indian-caused fires are constantly noted in most journals of the early explorers. For example, Fremont, while traveling near the Bear River in 1843, notes "On the creek were fringes of young willows, older trees being rarely found on the plains, where the Indians burn the surface to produce better grass" (1845:146). In another entry for the Snake River area he reports that "This is the fall or second growth, the dried grass having been burnt off by the Indians; and wherever the fire has passed, the bright-green color is universal" (1845:171).

In the ethnographic literature, Steward (1941) remarks that the burning of brush to facilitate growth of wild-seed plants was a common practice among the Nevada Shoshoni. Many of the Indian groups would burn the vegetation in the fall to promote goosefoot, Indian ricegrass, and certain species of Atriplex. In Utah and Nevada the Indians frequently burned off the sagebrush to maintain small grassy prairies (Stewart 1955b).

Besides just vegetation burning, the seeds of certain wild species actually may have been broadcast around campsites to provide a known food supply for next season. Steward (1938, 1941) mentions that many ethnographic groups in the Great Basin would burn brush in the fall and then sow seeds of such wild plants as goosefoot, Indian ricegrass, and mentzelia (Mentzelia sp.). Bye (1979) observed the Tarahumara Indians of western Mexico sowing the seeds and caring for a wild mustard (Brassica campestris) and a peppergrass (Lepidium virginicum), both members of the Cruciferae family. Beeweed was allowed to mature and to disperse its seed in Hopi fields (Whiting 1939).

Additionally, several weedy species, including goosefoot and sunflower, were domesticated as early as 4000 years ago in areas of the Midwest and Southeast (Cowan 1985). Evidence for domestication comes from morphological differences between the charred seeds recovered at archaeological sites and those of the modern wild species (Asch and Asch 1985; Yarnell 1978). The greater reliance during the Late Prehistoric period in southwest Wyoming on seeds from weedy species that are known to have been domesticated or, at least, cultivated in some areas, further implies that the prehistoric inhabitants of the area manipulated and encouraged some of these taxa.

As mentioned above, the prehistoric people of southwest Wyoming simply could have created suitable environments for the pioneer, weedy species by such means as fire or just allowing desirable plants to grow and disperse their seeds. Generally most hunters and gatherers, while adapting to the environment, have altered it as well. This is especially true in their relationships with plants. Blankinship (1905) notes that the extent to which many species are found in Montana, including sunflower and goosefoot, is largely due to their use as food by the Indians. Humans also have influenced the range of many species by unintentionally transporting viable seeds to other regions (Gilmore 1919).

OTHER POSSIBLE PLANT RESOURCES

Besides seeds, the ethnographic groups and most likely the prehistoric people of the western United States exploited other portions of plants including roots, leaves, and stems for food; however, direct evidence for their use would not be represented in the archaeological record. Of the plants providing edible roots, yampa (Perideridia gairdneri) was the most highly prized (Chamberlin 1911). While traveling through Wyoming in August 1843 Fremont noted:

At this place I became first acquainted with the yampah, (Anethum grareolens), which I found our Snake women engaged in digging in the low timbered bottom of the creek. Among the Indians along the Rocky Mountains, and more particularly among the Shoshonee or Snake Indians, in whose territory it is very abundant, this is considered the best among the roots used for food [1845:124].

Large quantities of these roots were gathered and cached in pits for winter use (Chamberlin 1911; Steward 1938). Other important root plants include checker lily (Fritillaria atropurpurea), spring beauty (Claytonia megarhiza), onions (Allium spp.), and sego lily (Calochortus nuttalli). Biscuit root (Cynnopterus bulbosus), fennel-leaved desert-parsley (Lomatium foeniculaceum), and wild rhubarb (Rumex hymenosepalus) are additional economic root plants that grow in the clayey flats in the valley just below the Buffalo Hump site.

These roots usually were roasted in pits lined with hot stones which were covered and left overnight (Chamberlin 1911). According to Smith (1974), the Ute would place the roots in a pit with a layer of heated rocks and damp grass in the bottom. Above the roots, another layer of grass and heated rocks were put in the pit. Finally, the oven was covered with cold rocks and dirt and left 24 hours.

The leaves and stems of many plants were another important food source for the ethnographic groups. Among these plants are arrowroot (Balsamorhiza sagittata), biscuitroot (Cymopterus longipes), buttercup (Ranunculus spp.), goosefoot (Chenopodium spp.), and bulrush (Scirpus spp.). They were eaten as greens after boiling them in water (Chamberlin 1911). The water usually was heated in a basket by adding hot rocks. Evidence for the use of these plants in the archaeological record would be the pits or the rocks. If the plants were in fruit at the time of use, a few seeds may accidentally have been charred and incorporated into features.

APPENDIX E

Pollen Analysis

Linda J. Scott

INTRODUCTION

Site 48SW5057 is located in the northern portion of the Great Divide Basin in Sweetwater County, Wyoming. The site is situated on a sand sheet between sandstone outcrop ridge spurs at an approximate elevation of 6800 ft. Pollen samples were collected from this site during archaeological mitigation to examine both the paleoenvironment and subsistence. Two separate stratigraphic columns were sampled at this site during the 1985 and 1986 field seasons. In addition, 32 samples were taken from features to examine the subsistence base. Occupation at this site ranged from approximately 1900 B.P. to 1250 B.P., with four separate cultural components in evidence.

METHODS

The pollen was extracted from soil samples submitted by Archaeological Services of Western Wyoming College from southwestern Wyoming. A chemical extraction technique based on flotation is the standard preparation technique used by Palynological Analysts for the removal of the pollen from the large volume of sand, silt, and clay with which they are mixed. This particular process was developed for extraction of pollen from soils where preservation has been less than ideal and pollen density is low.

Hydrochloric acid (10%) was used to remove calcium carbonates present in the soil, after which the samples were screened through 150 micron mesh. Zinc bromide (density 2.0) was used for the flotation process. All samples received a short (10 minute) treatment in hot hydrofluoric acid to remove any remaining inorganic particles. The samples were then acetolated for 3 minutes to remove any extraneous organic matter.

A light microscope was used to count the pollen to a total of 100 to 200 pollen grains at a magnification of 430x. Pollen preservation in these samples varied from good to poor. Comparative reference material collected at the Intermountain Herbarium at Utah State University and the University of Colorado Herbarium was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen and may be interpreted to represent pollen dispersal over short distances or the actual introduction of portions of the plant represented into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the pollen diagrams.

Groundstone was washed with distilled water and dilute hydrochloric acid to recover any pollen from the ground surface. Concentrations of pollen from the ground surfaces may represent plants ground using manos and metates. The ground surfaces had no appreciable quantity of dirt adhering to them. The surfaces were washed with distilled water and dilute hydrochloric acid, and scrubbed with a brush to release all trapped pollen. The resulting liquid was saved and processed in a similar manner to the soil samples, with the exception that the zinc bromide separation was not used. The metate that was rewashed was first

rinsed with distilled water in an effort to remove modern pollen that accumulated on the artifact during storage.

DISCUSSION

Site 48SW5057 is a multicomponent campsite on an east to southeast slope of a low ridge. The slope is gradual and forms a bench-like topography overlooking a shallow drainage basin. The area is flanked on the north by Cyclone Rim and on the south by Luman Rim. Buffalo Hump is located 4.6 km to the southwest and Bastard Butte 5.5 km to the northeast. Vegetation at the site included sagebrush (Artemisia); rabbitbrush (Chrysothamnus - a High-spine Compositae); several grasses (Gramineae) including wheatgrasses, Indian ricegrass, and bluebunch grass; and pricklypear cactus (Opuntia).

Two stratigraphic columns were sampled for pollen at this site to define paleoenvironmental conditions existing prior to the three occupations until the present. In addition, numerous features, including both pit structures and smaller pit features (Table 1), were sampled to gather subsistence data.

Four pollen samples were taken from the present ground surface in different areas to assess the variation in pollen rain between the drainage, valley floor, the general hillside, and the hillside within the site boundaries. The highest frequency of Cheno-am pollen was recovered from the valley floor, which also exhibited the lowest quantity of Artemisia pollen. The drainage exhibited slightly more Cheno-am pollen than Artemisia pollen as well as an increased frequency of Sarcobatus pollen. The hillside samples both contained larger Artemisia pollen frequencies than Cheno-am frequencies (Figure 1, Table 2).

Paleoenvironment

The pollen column taken during the 1986 excavation season (118.9N/308E) exhibits ten different soil strata. Three of these strata (III, V, and VII) represent cultural components at the site. Fluctuations in the pollen frequencies within this stratigraphic column indicate that variations have occurred in the quantities of the major components of the vegetation in the vicinity of this site through time, in response to changing paleoenvironmental conditions.

The lowest strata, I and II, exhibit relatively low frequencies of Cheno-am pollen, and larger quantities of both Artemisia and Gramineae pollen. These levels also exhibit a relatively high frequency of Pinus pollen, which declines towards the end of Stratum II. Stratum II contains a Neoglacial/Altithermal disconformity in the soils at 65 cm below surface. The quantity of Cercocarpus pollen in this portion of the pollen record is considerably higher than that observed in other strata, suggesting that these shrubs were more numerous in the paleoenvironment in the distant past than they are today. All of these fluctuations in pollen values point to a more mesic and/or cooler environment than the average at this site, although it may not be significantly cooler and/or moister than the present. The most interesting element of the samples representing Strata I and II at this site is the occurrence of Pediastrum. These algal colonies occur with high frequency in the lowest two samples from the stratigraphic column,

Table 1. Pollen types observed in samples from the Buffalo Hump site.

Scientific Name	Common Name
ARBOREAL POLLEN:	
<u>Abies</u>	Fir
<u>Alnus</u>	Alder
<u>Juniperus</u>	Juniper
<u>Picea</u>	Spruce
<u>Pinus</u>	Pine
<u>Quercus</u>	Oak
<u>Salix</u>	Willow
NON-ARBOREAL POLLEN:	
Campanulaceae	Harebell family
Cheno-ams	Includes amaranth and pigweed family
<u>Sarcobatus</u>	Greasewood
<u>Abronia</u>	Sand verbena/phlox
Compositae:	Sunflower family
<u>Artemisia</u>	Sagebrush
Low-spine	Includes ragweed, cocklebur, etc.
High-spine	Includes aster, rabbitbrush, snake-weed, sunflower, etc.
Liguliflorae	Includes dandelion and chickory
Cruciferae	Mustard family
Cyperaceae	Sedge family
<u>Ephedra</u>	Mormon tea
<u>Eriogonum</u>	Wild buckwheat
<u>Euphorbia</u>	Spurge
Gramineae	Grass family
Liliaceae	Lily family
Rosaceae	Rose family
<u>Amelanchier</u> -type	Serviceberry
<u>Cercocarpus</u> -type	Mountain mahogany
<u>Holodiscus</u> -type	Ocean-spray
Umbelliferae	Parsley family
<u>Urtica</u>	Nettle
<u>Pediastrum</u>	Green algae colonies

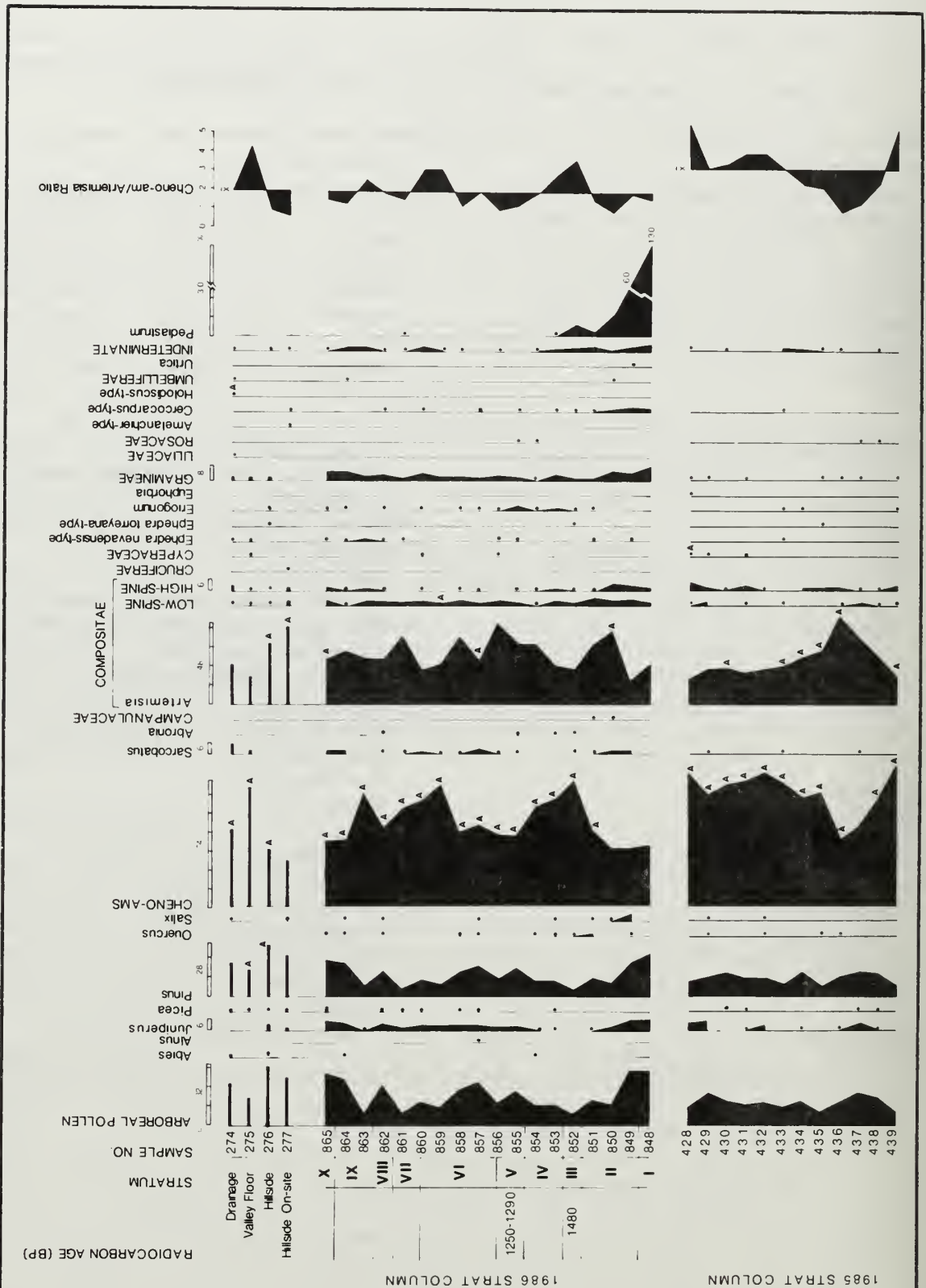


Figure 1. Stratigraphic pollen diagram from the Buffalo Hump site.

Table 2. Provenience of pollen from stratigraphic columns at the Buffalo Hump site.

Sample No.	Depth in cm below pgs*	Stratum	Soil Description/Estimated Age	Pollen Counted
1985 Stratigraphic Column				
428	Unknown	7		200
429	Unknown	7		200
430	Unknown	6		200
431	Unknown	5		200
432	Unknown	4		200
433	Unknown	3		200
434	Unknown	2		200
435	Unknown	2		200
436	Unknown	1		200
437	Unknown	1		200
438	Unknown	1		200
439	Unknown	1		200
1986 Stratigraphic Column				
865	0-5	X		200
864	5-10	IX	Soil disconformity - 8 cmbs**	200
863	10-15	IX		200
862	15-20	VIII		200
861	20-22	VII	Cultural Component 4	200
860	22-24	VI		200
859	24-29	VI		200
858	29-34	VI	Soil disconformity - 30 cmbs	200
857	34-39	VI	Interdunal ponding ca. 35 cmbs	200
856	39-41	V	Cultural Component 3	200
855	41-46	V	Cultural Component 3	200
854	46-52	IV		200
853	52-57	IV		200
852	57-62	III	Cultural Component 2	200
851	62-65	II	Neoglacial/Medithermal disconformity 65 cmbs	200
850	65-70	II		100
849	70-75	II		100
848	75-80	I	Disconformity on bedrock - 76 cmbs	100

*present ground surface

**centimeters below surface

decline rapidly, disappearing from the pollen record in Stratum IV. A single isolated occurrence of Pediastrum is noted again in Stratum VII. Pediastrum requires standing water for growth, indicating that water had at least puddled in this area of the site during the lowest strata prior to the occupational levels. Stratum I represents a surface older than approximately 3000 B.P. as the Neoglacial/Medithermal disconformity is recorded in the upper portion of Stratum II. Stratum I is overlain by a sand and clay stratum (Stratum II) which exhibited water retention from the time the site was opened in May until excavations were completed in July. It appears, then, that the Pediastrum observed in the highest frequencies in Strata I and II, represent ponded water, which was held by the fine clays in Stratum I.

Stratum III represents Cultural Component 2, which has yielded a radiocarbon age of 1480 B.P. This episode appears to be a considerably warmer and/or drier one than the previous periods. Pinus pollen decreases in this stratum, as does Artemisia and Gramineae. Cheno-am pollen, however, increases significantly. Conditions ameliorate as the pine pollen frequencies increase, along with the Artemisia frequencies, and the Cheno-am values decrease towards Stratum V, which represents Cultural Component 3. This component yielded a radiocarbon age of 1250 to 1290 B.P. The pollen record indicates that this interval marked a return to cooler, more mesic conditions. These conditions persisted, with variations, until a marked change was noted toward the end of Stratum VI, signalling a return to warmer and/or drier conditions. Pinus pollen then decreased, as did Artemisia pollen. Cheno-am pollen, however, increased during this period.

Fluctuations in the paleoenvironment mark Strata VII, VIII, and IX. Strata VII and VIII exhibit a return towards more average conditions, while Stratum IX evidenced fluctuations between slightly warmer and/or drier and cooler and/or more mesic conditions. The pollen sample taken from Stratum X exhibits a continuation of these slightly cooler and/or more mesic conditions, not unlike those represented by the frequencies of pollen recovered from the present ground surface on the hillside near the site.

Ratios are commonly used within pollen analysis in an effort to elucidate trends in the pollen data that may otherwise be obscured by the fluctuating pollen curves. A Cheno-am to Artemisia ratio was calculated for this site using raw data. It was hoped that this ratio would shed additional light on the fluctuations of these two major taxa, which fluctuate primarily in opposition to one another throughout the High Plains. Increasing Cheno-am values are associated with intervals of reduced effective moisture and increased soil alkalinity while increasing Artemisia values represent cooler and/or more mesic intervals, particularly when accompanied by increases in the Gramineae frequency. The ratios are diagrammed about the mean with deviations to the left indicating a cooler and/or moister conditions and while deviations to the right indicating warmer and/or drier conditions.

The Cheno-am/Artemisia ratio demonstrates fluctuations in the environment that suggest a cooler and/or more mesic situation through the Neoglacial/Medithermal disconformity between samples 850 and 851 in the upper portion of Stratum II. This is followed by a relatively short-lived change to warmer and/or drier conditions for the occupation in Stratum III (1480 B.P.) The change to cooler and/or more mesic

conditions is noted prior to the occupation at 1250-1290 B.P. (Stratum V continuing into Stratum VI), and includes a level (sample 857) which is noted to include evidence of interdunal ponding (Appendix F:13). This episode is followed by a short-lived return to warmer and/or drier conditions observed in samples 859 and 860. This warmer and/or drier interval may represent the short-lived intense warm/dry episode at 48LN1468 occurring after 900 B.P., perhaps corresponding with a drought recorded in the tree-ring record from 750-600 B.P. Fluctuations in the pollen record from the end of this stratum to the present ground surface record one additional warm/dry episode, which may reflect a similar warm/dry episode to that noted at 48LN1468. This may represent the drought observed in the tree-ring record from 357-377 B.P.

The Cheno-am/Artemisia ratio from the 1985 stratigraphic column contains similar ratios to those observed in the 1986 stratigraphic column, although some of the fluctuations appear more exaggerated. For instance, the relatively warm/dry conditions of Cultural Component 2 (Stratum III - 1480 B.P.) appears to be represented at the base of the column. An exaggerated cool/moist episode follows, encompassing Cultural Component 3 (Stratum V - 1250-1290 B.P.). A return to warm/dry conditions follows this episode, and the fluctuations from this point until the present ground surface appear to be truncated at this part of the site. Different pollen frequencies were observed near the top of this diagram from in the uppermost sample from the 1986 stratigraphic column. Apparently the top sample from the 1985 column represents a level below the present ground surface which was removed in the column area by Frontier pipeline construction.

The stratigraphic pollen column taken during the 1985 field season (125N/330E) was not correlated with specific soil strata as bad weather was encountered at the end of the field season which made assessment of the stratigraphic profile and the removal of the samples extremely difficult. The pollen column exhibits similarity throughout most of its depth to the column during the 1986 field season, although it does not appear to contain Strata I and II. The lowest portion of the 1985 stratigraphic column is consistent with the pollen record recovered within Stratum III, a period of occupation dated to 1480 B.P. This interval also appears to be warmer and/or drier than average in the stratigraphic column. A swing towards cooler and/or more mesic conditions is experienced through a depth that may correspond with Cultural Component 3, which dates to approximately 1250 to 1290 B.P. A warmer and/or drier interval is noted following this episode, and conditions immediately below the surface are registered as warmer and/or drier than average, rather than cooler and/or more mesic, which are indicated in the stratigraphic column from 1986.

Subsistence

Pollen types identified as representing plants that may have been exploited during one or more of the occupations of this site include Cheno-ams, Cleome, Artemisia, High-spine Compositae, Eriogonum, and Gramineae. A review of the ethnobotanic literature concerning specific utilization of these plants follows.

It is a commonly accepted practice in archaeological studies to reference ethnological (historic) plant uses as indicators of possible or even probably plant uses in prehistoric times. Ethnographic sources document that with some plants the historic use developed and carried

from the past. Although the ethnobotanic literature refers to Native American cultures from historic times and may not be relevant to specific uses of individual plants by prehistoric cultures, it does provide generalized information that will help answer questions about the past. In the case of southwestern Wyoming, ethnohistoric references to the specific area are rare, and it is necessary to rely on the ethnobotanic literature from the western United States. Repetitive references to the exploitation of resources indicate a widespread utilization and strengthen the possibility that the same or similar resources were used in prehistoric times.

Cheno-ams were exploited for both their greens (cooked as a potherb) and seeds. The greens are most tender when young, in the spring, but may be used at any time. The seeds are ground and used to make a variety of mushes and cakes (Chamberlin 1964:366; Gallagher 1977:12-16; Gilmore 1977:26, Harrington 1967:55, 57, 71; Rogers 1980:43, 66).

Artemisia seeds are oily and nutritious and are reported to have been widely gathered and used as a food. The leaves were also used to cover berries and food preserved in caches or to make a medicinal tea used in febrile conditions (Chamberlin 1964:362-363). Crushed sagebrush leaves were mixed with stored meat by the Blackfoot (Hellsen and Gadd 1974:101).

Eriogonum is rarely mentioned in the ethnobotanic literature. The stems may have been eaten raw or cooked while young. A tea may have been made and used medicinally, and the blossoms may have been mixed with organ meats and rubbed into hides to bleach them (Rogers 1980:84).

Members of the Gramineae family, particularly Oryzopsis, may have been widely used as a food resource. Oryzopsis produces an abundant quantity of seeds which were utilized by many Native American groups, including the Gosiute (Chamberlin 1964:375). The seeds were often ground into meal to make various mushes and cakes (Harrington 1967:322). Several other species of grasses are also noted to have been used for their seeds, and the young shoots and leaves may have been cooked as greens (Rogers 1980:32-40). Grass is also reported to have been used as a floor covering (Chamberlin 1964:372).

Polygonum sawatchense is not specifically referenced as having been used. Other species of Polygonum are reported to have been used for their roots, which are starchy and may have been roasted, and young leaves, which were used as potherbs and for seasoning. In addition, the seeds of several species of Polygonum may have been parched and ground into meal (Harrington 1967:196-198; Rogers 1980:84).

Three general types of features were excavated and sampled for pollen at the Buffalo Hump site. They include pit structures, smaller features within pit structures, and also pit features outside the pit structures (Figure 2). In general, the pit structures average two meters in diameter and are characterized by a circular pattern of sandstone rocks and stained soil. The pit structures are saucer-shaped and contain a maximum depth of 40 cm of dark fill. This dark fill was sampled vertically in 5 cm intervals to obtain a pollen record for the fill (Figure 3). The floors of the pit structures themselves average approximately 4 cm in thickness. A trash midden was documented on the leeward side of one of the pit structures. The features will be discussed by cultural component and spatial distribution across the

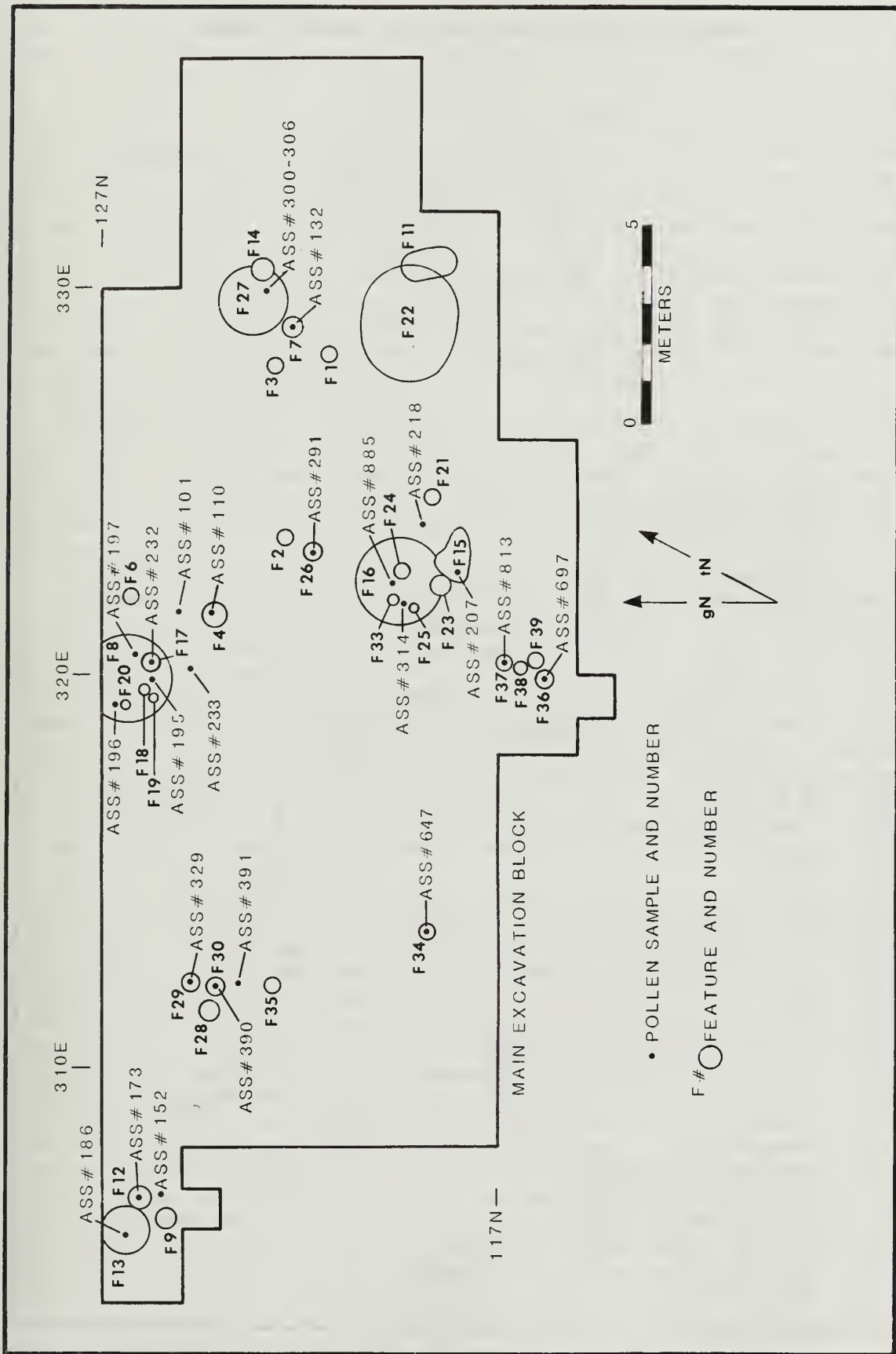


Figure 2. Illustration of the locations of all pollen samples.

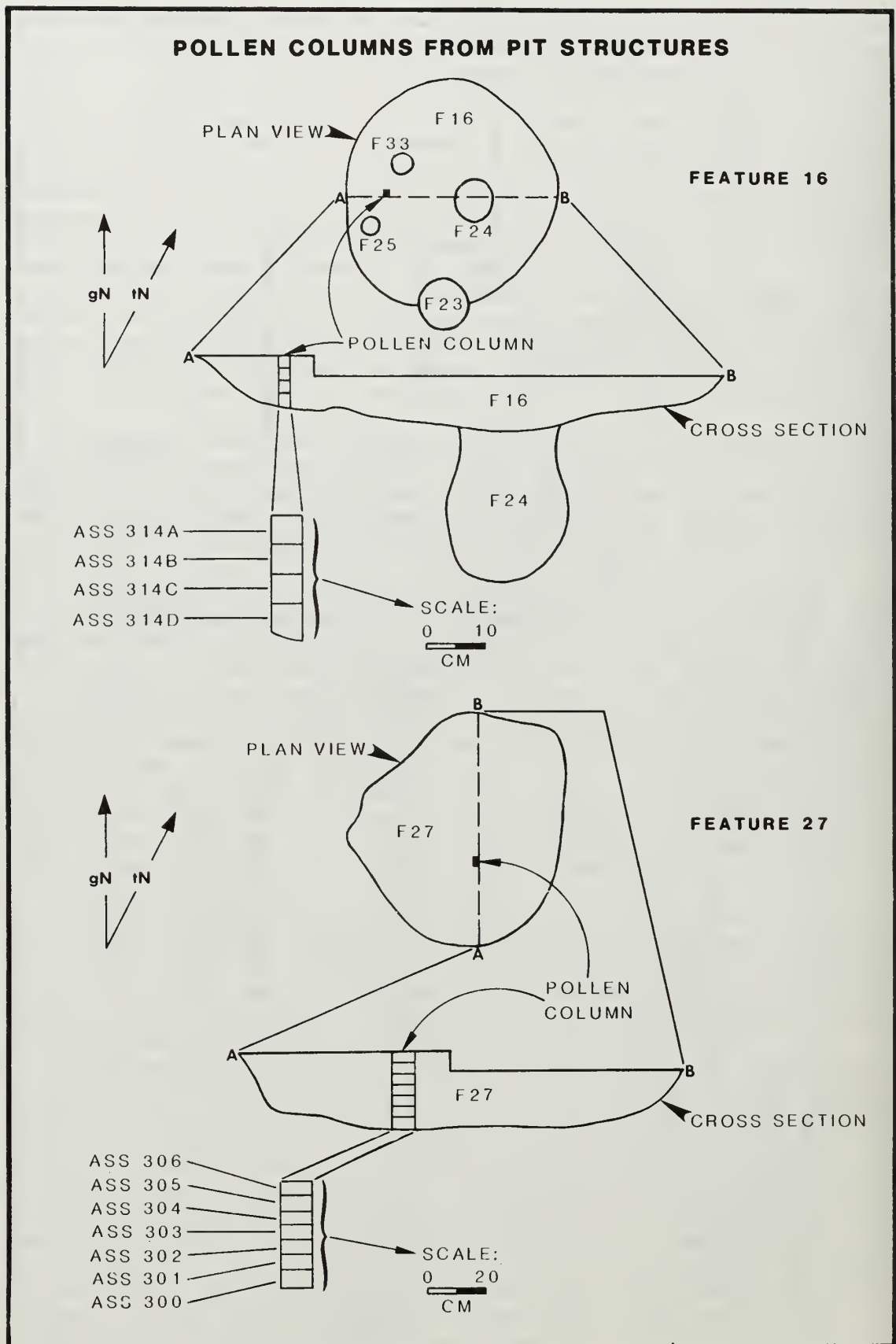


Figure 3. Illustration of the sizes and locations of pollen columns taken from the two pit structures in Component 2, showing designated sample numbers.

site. Several features are assumed to belong to the same cultural component because they occurred in the same vicinity and stratum.

Cultural Component 1 is represented by a single feature (Feature 4), which yielded a radiocarbon age of 1870 ± 80 B.P. This feature was a large, shallow, basin-shaped pit that contained evidence of oxidation in discontinuous patches on the sides and bottom. A pollen sample (110) was taken above the black fill that lined the bottom of the pit (Table 3). A second pollen sample (101) was taken 40 cm north of the feature on the presumed living surface associated with the feature. The pollen record in these two samples exhibits a higher frequency of Cheno-am pollen in the fill of the feature than was observed outside the feature (Figure 4). This suggests that Cheno-am seeds may have been parched in this firepit, or the greens cooked. Aggregates of Cheno-am pollen were noted both from the fill of the feature and the sample taken from the living surface to the north of the feature, indicating Cheno-am processing in this vicinity.

Cultural Component 2 included two pit structures (Features 27 and 16). Numerous smaller features were associated with each of these pit structures. In addition, a concentration of small, exterior pits were noted to the southwest of Feature 16 as well as an isolated feature to the west of Feature 16 which appeared to be elements of this same cultural component.

Feature 27 was located in the eastern portion of the excavated area at the site. This pit structure is described as a large, shallow, circular depression with moderately sloping margins and a relatively flat bottom. The lower 10 cm of fill was a very dark, charcoal-stained soil which was covered by 30-40 cm of a loose, tan, sandy fill containing large flecks of charcoal. No interior floor features were present in this pit structure although a single feature (Feature 7) located on the southwest margin of the pit structure was also sampled for pollen. This feature was a basin-shaped pit exhibiting sloping sides and a rounded bottom. Oxidation was evident on the sides of the pit, and the fill was a dark brown to black, charcoal-stained soil. The pollen sample was extracted from an undisturbed portion of the fill at the center of the feature.

The stratigraphic pollen record representing the pit structure (Feature 27) exhibits a large quantity of Artemisia pollen in samples from the floor and lower 10 cm of fill. This may be associated either with natural pollen rain or with increased deposition of sagebrush pollen resulting from the use of sagebrush in building the superstructure. If the superstructure had been constructed during the time of year when sagebrush flowers were developing or shedding their pollen (late summer and fall), increased deposition of this pollen type would be expected both inside the structure and in nearby features. The floor and lower fill sample also exhibit moderate frequencies of Cheno-am pollen and aggregates of this pollen type. The frequencies of Cheno-am pollen increase above these levels and remain relatively high throughout the fill of this feature. The presence of a relatively large number of Cheno-am aggregates in the loose, tan, sandy fill may be associated with the growth of saltbush within the pit structure depression. Cheno-ams yielded slightly to Artemisia in the upper portion of the fill, suggesting that the Cheno-ams were among the first plants to colonize the abandoned feature depression and were followed by sagebrush.

Table 3. Provenience of pollen samples from features at the Buffalo Hump site.

Sample No.	Feature No.	Component	Comments	Pollen Counted
101	4	1	Large, basin-shaped pit, 1870 $\pm$ 80 B.P.	200
110	4	1	Large, basin-shaped pit, 1870 $\pm$ 80 B.P.	100
132	7	2	Medium, basin-shaped pit	200
195	8	3	Pit structure	100
196	8	3	Pit structure	100
197	8	3	Pit structure	100
152	9	3	Medium, basin-shaped pit	200
173	12	3	Large, bell-shaped pit	Insuff
186	13	3	Large, shallow basin	100
207	15	2	Midden concentration	200
218	15	2	Midden concentration	200
314	16	2	Pit structure	200
232	17	3	Large, bell-shaped pit, 1290 $\pm$ 60 B.P.	200
233	17	3	Large, bell-shaped pit, 1290 $\pm$ 60 B.P.	200
291	26	2	Medium, basin-shaped pit	Insuff
300	27	2	Pit structure	200
301	27	2	Pit structure	200
302	27	2	Pit structure	200
303	27	2	Pit structure	200
304	27	2	Pit structure	200
305	27	2	Pit structure	200
306	27	2	Pit structure	200
329	29	3	Medium, basin-shaped pit	100
391	28/29/30	3	Feature cluster	100
390	30	3	Medium, bell-shaped pit, 1250 $\pm$ 60 B.P.	Insuff
647	34	2	Small, basin-shaped pit	100
697	36	2	Medium, basin-shaped pit	200
813	37	2	Small, basin-shaped pit	100
885	16	2	Metate wash	100
274			Modern sample, drainage	200
275			Modern sample, valley floor	200
276			Modern sample, hillslope	200
277			Modern sample, on-site	200

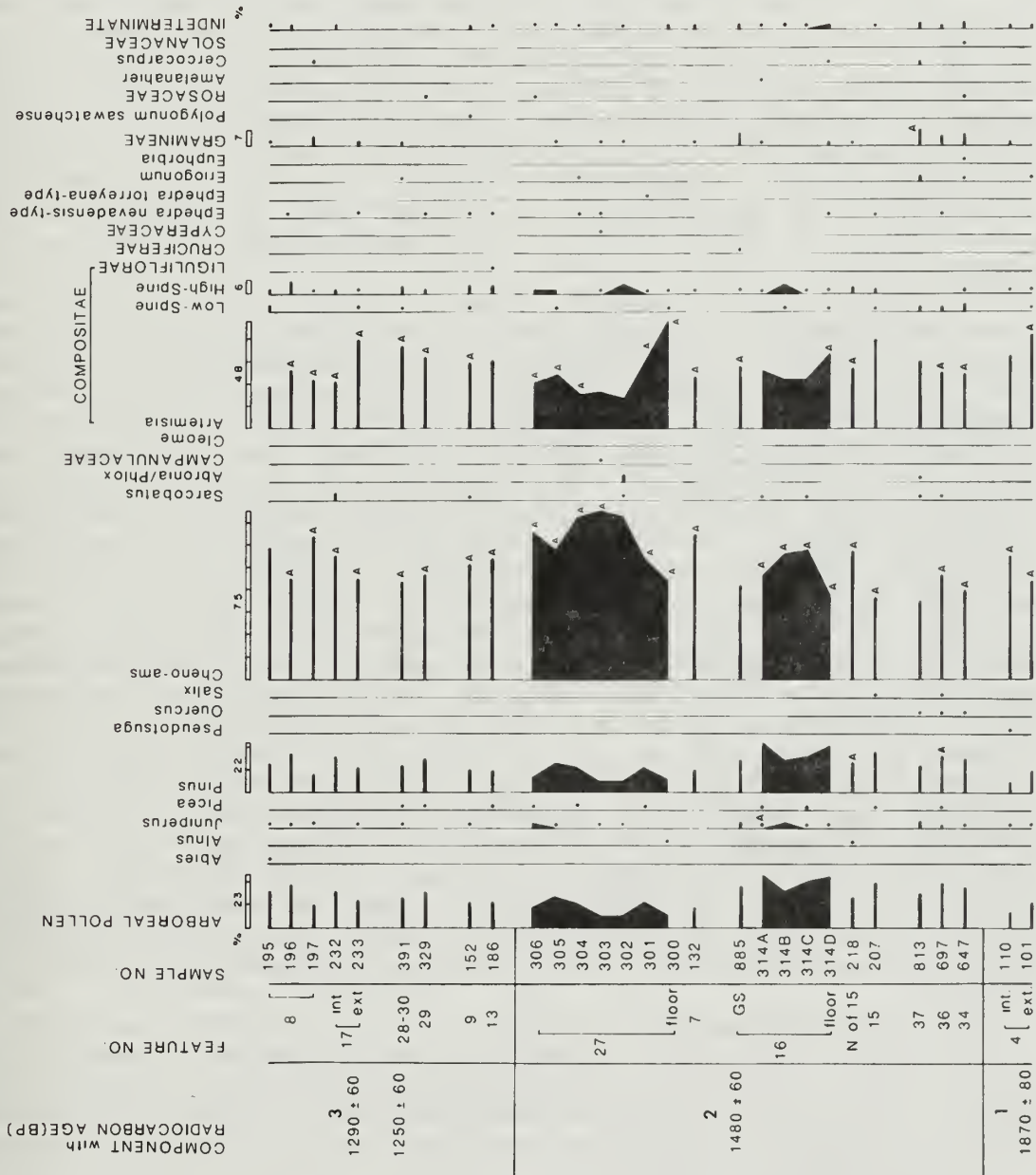


Figure 4. Pollen diagram of features at Buffalo Hump site.

Feature 7, the adjacent small pit, yielded a large quantity of Cheno-am pollen, accompanied by aggregates, suggesting the Cheno-am seeds and/or greens were processed in this feature outside the structure.

Feature 16 is a pit structure that may be described as a large, shallow, circular depression exhibiting sloping margins and a relatively flat bottom. The fill of this structure was stratigraphically sampled for pollen through a matrix that contained more gravels than the surrounding soil and was noted to be a dark, charcoal-stained soil in the bottom 3 cm of the depression. A single feature (Feature 15), located to the south of the pit structure, was sampled for pollen. This feature is described as a distinct, shallow concentration of black, charcoal-stained soil containing fire-cracked rock. It is possible that this feature represents a midden associated with the pit structure on its leeward side. A single piece of groundstone was recovered from the fill of this structure and was washed for its pollen content.

The stratigraphic samples taken from the fill of this pit structure (Feature 16) exhibit relatively high frequencies of Cheno-am pollen throughout the fill, suggesting that Cheno-ams grew within the pit structure depression following its abandonment. Sample 314D, representing the floor of the structure, exhibits an abundance of Cheno-am aggregates, suggesting the Cheno-ams may also have been processed during occupation. This pit structure contains an elevated Artemisia pollen frequency in the pollen sample removed from the floor, which is reminiscent of the pollen record in Feature 27. Although the frequency of sagebrush pollen associated with the floor is not as elevated within Feature 16 as it is in Feature 27, this pattern suggests that the superstructures of both structures may have been constructed using sagebrush. As in Feature 27, the vegetation changed near the end of the fill sequence to include more sagebrush. High-spine Compositae pollen is noted to peak in the light fill in each of these pit structures and may be associated with disturbance plants occupying the depression. A single grain of Cleome pollen was recovered from sample 314B, taken in the upper fill of this pit structure. It appears that the presence of Cleome may be associated with postoccupational accumulation and the growth of disturbance plants in the fill. It is possible, however, that the presence of Cleome pollen may be explained through wind transport of this pollen from other features on this site into the postoccupational fill of Feature 27.

Sample 885 represents the metate that was recovered from the fill of Feature 16. This sample contains similar frequencies of most pollen types to those recorded in the sample taken from the floor of the structure, with the exception of Gramineae pollen. The large value of Gramineae pollen recovered from this sample suggests that grass seeds were ground using this metate.

A pollen sample was taken from within Feature 15, the distinct charcoal lens located to the south of the pit structure. This sample yielded a higher frequency of Artemisia pollen than was recovered in other nearby samples, suggesting that sagebrush may have been used as a fuel either in this feature or in another feature which may have been cleaned out and its contents deposited in this area or that sagebrush may have been a major constituent in the construction of the shelter

over the adjacent structure. A relatively large quantity of Cheno-am aggregates were observed within the sample from Feature 15, suggesting that Cheno-am seeds may have been processed or their remains discarded in this area. The pollen sample (218) taken to the north of Feature 15 exhibits a relatively high frequency of Cheno-am pollen, as well as a small quantity of Cheno-am aggregates. It is possible that the increased frequency of Cheno-am in this sample represents Cheno-am processing in this area.

Two small, exterior features from Component 2 to the southwest of the pit structure (Feature 16) were sampled. Feature 37 was a small, shallow, circular basin exhibiting gradually sloping sides and a rounded bottom. Although this feature contained no fire-cracked rock, the fill was a uniform, dark brown, charcoal-stained soil. Oxidation was observed in patches on the sides of the feature. The pollen sample (813) was taken from the center of the feature, within 5 cm of the bottom. Feature 36 was a shallow, circular basin also exhibiting sloping sides but with a flat bottom. The fill contained fire-cracked rock throughout the charcoal-stained soil, and no oxidation was observed. Again, the pollen sample was taken (697) from the center of the feature within 5 cm of the bottom. The pollen content of these two features is relatively similar, although certain differences are apparent. Sample 697, representing Feature 36, exhibits higher frequencies of both Cheno-ams and aggregates of this pollen type than does Feature 37. It should be noted that Feature 36 contained fire-cracked rocks whereas Feature 37 did not. Both samples contained Gramineae pollen although the frequency was greater in Feature 37 where aggregates were observed. This feature also contained Eriogonum pollen. The pollen record suggests that Feature 37, which did not exhibit fire-cracked rock, may have been used for processing Gramineae and Eriogonum seeds. Feature 36, on the other hand, did contain fire-cracked rock and appears to have been used for processing Cheno-ams. The Gramineae pollen frequency was moderate and may reflect grass seed processing as well.

Feature 34 also represents Cultural Component 2 and was located approximately 10 m to the west of Feature 16. Feature 34 was a small shallow, circular, basin-shaped pit with steep sides and a rounded bottom. No fire-cracked rock was recovered from the dark charcoal-stained soil although a concentration of rock and bone was recovered directly to the east of the pit in clear association. Pollen Sample 647 was taken from the center of the feature within 5 cm of the bottom. The pollen record from this feature exhibits a moderate frequency of Cheno-am pollen and numerous small aggregates of this pollen type. A small quantity of Solanaceae pollen was recovered from this feature, and the Gramineae is slightly higher than average. The pollen record suggests that this feature may have been used in the processing of Cheno-ams, or that Cheno-am may have been used to season or cook with other foods within this feature, and that members of the Gramineae and Solanaceae plant families may have also been processed.

Cultural Component 3 is represented by a single pit structure and numerous other features. This component yielded radiocarbon ages of 1290 ± 60 B.P., and 1250 ± 60 B.P.

Feature 8 was a pit structure located to the northwest of Feature 16. This pit structure is described as a large, shallow, circular depression with very gradually sloping margins and a rounded bottom.

Three deflation surfaces were evident within the fill, suggesting that the structure was occupied over time. Three pollen samples were taken from the floor of this pit structure: from the north half of the northwest quarter (196), the south half of the northeast quarter (197), and the center of the south half (195). The one interior pit, Feature 17, was a deep, circular pit exhibiting a constricted neck, belled sides, and a rounded bottom. The bottom of the feature was filled with black-stained soil and a layer of fire-cracked rock. Above this was a moderately charcoal-stained fill, from which the pollen sample (232) was taken. The pollen was taken at the base of this layer near the contact with the darkest fill. Sample 233 was taken from the occupation surface in association with Features 8 and 17. The sample was actually taken 60 cm south of the edge of Feature 8 and 1 m south of Feature 17.

The pollen content of the pit structure (Feature 8) indicates that Cheno-ams may have been processed throughout the structure. The highest frequencies of Cheno-am pollen were recovered in samples taken to either side of Feature 17 while Sample 196 from the northwest portion of the pit structure exhibited numerous aggregates of Cheno-am pollen. Sample 196, in the northwest corner, also yielded the highest frequency of High-spine Compositae pollen, suggesting that this resource may have been processed in this area. Sample 197, located in the eastern portion of the pit structure, exhibited the highest frequency of Gramineae pollen, suggesting that this resource may have been processed in this area of the pit structure. Sample 232, representing the interior fill of the pit feature (Feature 17) sampled within the pit structure, contained a relatively large quantity of Cheno-am pollen as well as numerous aggregates of this pollen type. This appears to indicate that Cheno-am seeds may have been roasted in the feature or Cheno-am greens cooked or used in the cooking process of other foods. Sample 233, taken outside and to the southeast of both features, exhibits a smaller quantity of Cheno-am pollen than was recovered from within the features and a greater quantity of Artemisia pollen, suggesting that this may reflect the natural pollen rain at the time of occupation or that the pollen rain in this area was artificially influenced by the downwind position and proximity of this sample to the probable sagebrush superstructure covering Feature 8. The presence of aggregates of Cheno-am pollen in this sample signal the possibility that Cheno-am processing may have occurred outside the structure.

A cluster of small pit features (Features 28, 29, and 30) were located to the southwest of Feature 8 and are associated with Cultural Component 3. This group of three features was originally described as a "tri-hearth" feature, although the discovery of a fourth nearby feature (Feature 35) contradicts this term. Feature 28 was a shallow, circular, basin-shaped pit exhibiting moderately sloping sides and a rounded bottom. It contained dark, charcoal-stained soil with a small amount of fire-cracked rock. Feature 29 was a small, circular, basin-shaped pit with steep sides and a rounded bottom containing a mottled charcoal soil which darkened with depth and a few pieces of fire-cracked rock. Pollen sample 329 was taken from the top of this feature in the southeast quarter. Feature 30 was a deep, circular pit exhibiting steep sides and a rounded bottom and with oxidation evidenced on the sides. The fill was a mottled, charcoal-stained soil that darkened toward the bottom and contained fire-cracked rock.

Pollen sample 390 was taken from Feature 30 but did not yield a sufficient concentration of pollen for analysis. Pollen sample 391 was taken 60 cm southeast of Feature 28 and 70 cm south of Feature 30 on the exterior occupation surface. Sample 329 represents the fill of Feature 29. Both pollen samples 391 and 329 contain similar pollen frequencies, which are not sufficiently different to indicate food processing in either of these areas.

Features 9, 12, and 13 are the westernmost features examined for pollen and appeared to be associated with Cultural Component 3. Feature 13 was the largest. It was a large, roughly circular, shallow basin with gradually sloping sides and an undulating bottom. No oxidation was observed, and only a single piece of fire-cracked rock was recovered from the charcoal-stained soil. Pollen sample 186 was taken from the center of the feature, which may represent a dump area for Features 9 and 12. Feature 9 was a small, shallow, circular, basin-shaped pit with gradually sloping sides and a rounded bottom. Oxidation was observed around the upper sides, and the fill was noted to be charcoal-stained and contained a few pieces of fire-cracked rock. The pollen sample (152) was taken 50 cm to the east of the edge of the feature on the associated occupational surface. Feature 12 was a deep, circular pit exhibiting slightly belled sides and a flat bottom. Oxidation was present on the sides of the pit, which was filled with a uniformly black, charcoal-stained soil and a few pieces of fire-cracked rock. A large, unmodified sandstone slab capped this feature, and the pollen sample (173) was removed from directly beneath the slab. Unfortunately, there was not a sufficient concentration of pollen in the sample to yield a count. The pollen samples from the occupation surface near Feature 9 and Feature 13, the dump area, are very similar to one another. Numerous aggregates of Cheno-ams were processed in this area. A single grain of Polygonum sawatchense pollen was recovered from this sample, suggesting that this plant may have been processed or its remains discarded in this area.

A previous study of the pollen and macrofloral remains at this site (Scott 1984) indicated that sagebrush was used as fuel and that Cheno-ams and Opuntia were probably processed near and cooked in a hearth that yielded a radiocarbon age of 1250 ± 60 B.P. An abundance of charred Chenopodium and Amaranthus seeds were recovered from this feature.

A roasting pit that yielded a radiocarbon age of 1420 ± 50 B.P. contained pollen suggesting that Cheno-ams and grasses were processed and that sagebrush was used as fuel. A second roasting pit that yielded a radiocarbon age of 1840 ± 120 B.P. exhibited charred Chenopodium seeds and pollen that indicated that Cheno-ams, grass, and pricklypear may have been cooked in the roasting pit. Sagebrush was used as fuel. The rich subsistence record of these three features suggests that plant processing may have been a very important activity at this site.

SUMMARY AND CONCLUSIONS

Pollen analysis at the Buffalo Hump site encompassed both an examination of the paleoenvironment and the vegetal portion of the subsistence record. Paleoenvironmental data were obtained through the

analysis of two separate stratigraphic columns taken at this site. The stratigraphic column taken during the 1986 mitigation was correlated with the cultural strata, making it the more valuable for paleoenvironmental reconstruction. Local and regional conditions proved to be more mesic and/or cooler during Strata I and II and represent the Neoglacial and perhaps earlier episodes which exhibit high pine frequencies representing regional vegetation, and higher frequencies of Artemisia and Gramineae pollen. Also abundant within these strata were Pediastrum, which are algae that flourish in standing water. Environmental conditions change abruptly in the pollen record at Stratum III, which represents Cultural Component 2 (1480 B.P.). These warmer and/or drier conditions are substantiated on a regional level by the drop in pine pollen frequencies, and are interpreted from the more local evidence of decrease in Artemisia and Gramineae pollen and increases in Cheno-am pollen. It should be noted that since this pollen column was taken from the site area, the increase in Cheno-am pollen during a period of occupation may relate in part to disturbance of the ground and vegetation onsite. Cooler and/or more mesic conditions are observed through Cultural Component 3 (1250 to 1290 B.P.) and continuing until approximately the middle of Stratum VI. This is followed by an abrupt change to warmer and/or drier conditions which persist until the interface with Stratum VII. Fluctuating conditions deviate from the average first as cooler and/or more mesic, then as warmer and/or drier, and finally, as slightly cooler and/or more mesic than average conditions which persisted until the present period. These paleoenvironmental trends are similar to those observed in other sites in southwestern Wyoming, including 48LN1468, where relatively warm and/or dry conditions were observed approximately 1500 B.P. followed by cooler and/or more mesic conditions near 1200 B.P. and a return to a short-lived warmer and/or drier episode at 900 B.P. (Scott 1987). Again, local conditions were seen to fluctuate between 900 B.P. and the present period.

Limited evidence of food processing activities was recovered from the pollen record at this site from both the previous study and this one. Cheno-am processing appears to have been a regular activity in most of the features, including the pit structures, and all types of smaller oxidized and unoxidized pit features. Very limited evidence for the processing of other food items, such as Cleome, Eriogonum, Gramineae, and members of the High-spine Compositae group, and possibly Opuntia, Solanaceae, and Polygonum sawatchense, was recovered. The pollen record suggests that the most frequently used fuel at this site was Artemisia (sagebrush). There does not appear to be a distinction between the plants utilized for the three occupational components. Artemisia (sagebrush) also appears to have been a major constituent in the construction of the shelter over Feature 27 and, perhaps, also over Feature 16. Both depressions exhibit significantly larger quantities of Artemisia pollen in the samples removed from the floor than in other samples associated with the upper portions of the fill. Also, some evidence of a sagebrush superstructure over Feature 8 may be reflected in the elevated quantity of Artemisia pollen from a sample taken directly exterior to and downwind of the pit structure.

APPENDIX F

***Sedimentology, Stratigraphy & Climatic
Interpretations***

J.C. Miller

The Buffalo Hump site is located in the northern Great Divide Basin, an informal section of the Wyoming Basin province of the Rocky Mountain System Division (Fenneman 1946). The site itself is situated on an uplifted block of sedimentary rock bounded by a fault to the south and apparently "hinged" to the north. Archaeological deposits at the site are contained within an eolian shadow deposit that has aggraded in a late Pleistocene drainage feature.

PHYSIOGRAPHY

The site is located on an uplifted block of the Tipton and Wilkins Peak members of the Green River Formation and the Cathedral Bluffs Tongue of the Wasatch Formation. Buffalo Hump, located just west of the site, is the highest feature of the uplifted block and is a weathered knob of the Cathedral Bluffs Tongue of the Wasatch Formation. Site 48SW5057 itself is underlain by interbeds of the Tipton member and the Cathedral Bluffs Tongue, these units comprise the parent material of the site deposits.

The site materials are contained within an eolian shadow deposit that has mostly filled a concave up depression produced by headward erosion during the late Pleistocene. The fill probably began to aggrade before ca. 10,000 years B.P., based on evidence from other sites far to the west (Hoefer 1987; Miller and Bower 1986; Miller and James 1987). Albrandt (1974:56) states that the start of deposition in the Killpecker dunes, just south of the site locale, began about the same time.

In addition to shadows, other eolian features are common in the area. The Killpecker dunes to the south contain a variety of dunes, some active, others stabilized, and dunes occur throughout the area. On Buffalo Hump's flank leading down to the site location, dome dunes are notable; although active, they are thought to be relatively recent in formation and are currently stabilized. In the site profiles, falling dome dunes encroached on the site and were incorporated in the site deposits.

Local topography can be described as tableform because of the weathering character of the Green River Formation. Cuestaform topography is evident as are minor badland exposures. The area gives the impression of a moderately dissected pediment in areas; dissection, however, has been aided in fault zones by alluvial systems and perhaps gradient changes.

Playas and low gradient alluvial valleys are evident. Bush Lake, southeast of the site, and Bush Creek Valley, to the east of the site, are examples of these land forms. Playa deposits are exceptionally old in the Great Divide Basin because the basin is internally drained; the Continental Divide passes on both sides of the basin. The normal association of playas and eolian deposits is not wholly true here. The low gradient streams have been particularly affected by eolian deposits.

THEORETICAL CONSIDERATIONS

Deposits on the site are characteristically eolian although source materials determine the actual population distribution and statistical

facts. The deposits can be defined in periods of deposition that are either arid or mesic, dependent upon the population character. Eolian deposits of interpluvial, or arid, periods are defined generally by poorer sorting because of the variety of particle sizes that are transported over stripped or devegetated surfaces. Also, they are more highly leptokurtic and slightly negatively skewed sedimentologically. Deposits in aggregations occurring during pluvial periods are slightly leptokurtic to slightly platykurtic, finely positively skewed, and exhibit better sorting compared to arid deposits. Deposits of dunes and shadows are similarly differentiated. Dunes display marked variation within a deposit, whereas shadow deposits are overall more homogeneous in their sedimentological character. Agreement with pollen data is always featured with the possible exception of transition periods between deposits of pluvial periods to those of interpluvial periods or vice versa. From data so far obtained, it appears that the pluvial to interpluvial transition is relatively abrupt compared to perhaps a 200- to 300-year lag in interpluvial to pluvial transitions.

Once deposits are in place, pedological development proceeds at varying rates. In cooler, wetter periods, enhanced soil moisture due to increased precipitation and the direct precipitation itself alters the rate of formation of illuvial, eluvial, and organic horizons. These effects are additive in the older deposits and, as such, the deposits with the greatest development are representative of numerous developments, whereas the more recent deposits have had shorter times for development. Temperature is logically important as it controls the rates of reactions that control eluviation or weathering in place. The apparent difference of development rates in separate events may be due to the average temperature of the deposit during the times of formation.

Once this development has been allowed to proceed, for at least an estimated 500 years or so, the development of the illuvial and eluvial zones becomes indurated to the extent that eolian processes are not able to affect them to any extent. They form barriers to subsequent deflation that occurs in interpluvial intervals. These ancient surfaces are marked in the analytical results by more severe negative skewness due to "stranded" coarse particles and, commonly, a bimodal population distribution with modes indicated by the primary deposit, i.e., eolian, and a second mode on the coarse end of the curve produced by the stranded particle. In nearly all cases, these zones of deflation directly overlie the surface of the illuvial/eluvial zone which fine skews the curve by varying degrees dependent upon the period in which the deposits were subject to modification. The combination illuvial/eluvial zones encountered represent two separate events. The eluvial formation is the most ancient, the illuvial development much younger. The illuvial development is the translocation of fine particles and soluble mineral matter downward from the surface. Expectedly, in a short pluvial (ca. 10 to 20 years), the illuvial development would move the upper eluvial development down the profile; and in a subsequent interpluvial event, the materials denuded of these fine particles could be removed.

Depth of shadow deposits, and thus of various eluvial developments, is dependent on the size of obstruction that allows the shadow to form. This is secondarily controlled by altitude. Higher altitudes, by virtue of increased orographic precipitation, decrease the amount of material available for transport in these settings. This holds true regardless

of climatic conditions. For example, 48SW5215 on the Rock Springs Uplift always received more precipitation because of its location than did 48SW5057 in the northern Great Divide Basin. Both sites, however, received less precipitation during arid intervals. Sites 48FR1602 and 48FR1468 share similar positions with respect to orographic barriers as 48SW5215.

All sites in southwest Wyoming thus far subject to this type of laboratory analysis show a characteristic train of events in the depositional history and pedological development, and this includes the site addressed here. On rudimentary interpretations there would appear to be large deviations from the proposed model, but these are explicable where the parent material and its sedimentological character are considered. For example, sites 48FR1468 and 48FR1602 are contained within eolian deposits derived from the Battle Springs Formation, a coarse conglomeratic fluvial/alluvial complex, in contrast to sites such as 48SW5057 and 48SW5215 which are within eolian deposits derived from lacustrine deposits of the Green River Formation. Where the Green River Formation provides ample smaller particles that delimit the illuvial/eluvial developments in profile, the Battle Springs Formation is nearly devoid of these sizes and the developments are not so notable. In the latter case, these zones are best defined by chemical and physical attributes of the sediment rather than particle accumulations.

METHODOLOGY

Sampling Methodology

During the investigations on the site, detailed stratigraphic profiles of certain walls of the excavation block were drawn. Based on these, samples were drawn in order to analyze the depositional history of the site from a time before the cultural occupations to the present. A complete column was taken. Each identified level was sampled completely in blocks no greater than 5 cm in vertical height. Identified stratigraphic boundaries (paraconformities) were the boundaries for sampling within identifiable units. Sample weights varied between 30 and 50 g.

Laboratory Methodology

In the laboratory, the samples were split using a Jones Type splitter. Split portions were used to examine aspects of grain size, grain morphology, geochemistry, and genesis. Grain size was determined by sieving and settling tube. Sieves were used with openings equivalent to Krumbein's (1934) ϕ (phi) scale, the negative log (base two) of Wentworth's (1922) grain size scale. Table 1 relates metric and phi sizes. As recommended by Folk (1974:31), $\frac{1}{2}\phi$ increments were used. All weights were taken to .0001 g accuracy. For each sample, a histogram of ϕ size versus weight percent and a log probability plot of ϕ versus cumulative percent coarser were completed. Histograms were used to determine genesis of grain populations and mode, and the latter graph's utility was in the determination of the statistical parameters of the grain size population (i.e., mean, mode, standard deviation or sorting, skewness, and kurtosis). Table 2 gives the formulae used to derive the

Table 1. Comparison of U.S. Standard Mesh, mm, Phi (ϕ) size and Wentworth size classes (Pettijohn et al. 1972).

US Standard sieve mesh	Millimeters		Phi (ϕ) Units	Wentworth size class	
Gravel	4096		-12	boulder	
	1024		-10		
	256	256	-8		
		64	64	-6	cobble
	5	16 4	4	-4 -2	pebble
	6	3.36		-1.75	granule
	7	2.83		-1.5	
	8	2.38		-1.25	
	10	2.00	2	-1.0	
	Sand	12	1.68	1	-0.75
14		1.41		-0.5	
16		1.19		-0.25	
18		1.00	1	0.0	
20		0.84		0.25	coarse sand
25		0.71		0.5	
30		0.59		0.75	
35		0.50	1/2	1.0	
40		0.42		1.25	medium sand
45		0.35		1.5	
50		0.30		1.75	
60		0.25	1/4	2.0	
70		0.210		2.25	fine sand
80		0.177		2.5	
100		0.149		2.75	
120		0.125	1/8	3.0	
140		0.105		3.25	very fine sand
170		0.088		3.5	
200		0.074		3.75	
230		0.0625	1/16	4.0	
Silt	270	0.053		4.25	coarse silt
	325	0.044		4.5	
		0.037		4.75	
		0.031	1/32	5.0	
		0.0156	1/64	6.0	medium silt
		0.0078	1/128	7.0	fine silt
		0.0039	1/256	8.0	very fine silt

Table 1. Concluded.

US Standard sieve mesh	Millimeters	Phi (Ø) Units	Wentworth size class
Clay	0.0020	9.0	clay
	0.00098	10.0	
	0.00049	11.0	
	0.00024	12.0	
	0.00012	13.0	
	0.00006	14.0	

Table 2. Graphical determination formulae for selected statistical parameters (Folk 1974).

$$\text{graphic mean grain size } (M_z) = \frac{\phi_{16} + \phi_{50} + \phi_{84}}{3}$$

$$\text{inclusive graphic standard deviation } (s_1) = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$$

$$\text{inclusive graphic skewness } (sk_1) = \frac{\phi_{16} + \phi_{84} - 2\phi_{50}}{2(\phi_{84} - \phi_{16})} + \frac{\phi_5 + \phi_{95} - 2\phi_{50}}{2(\phi_{95} - \phi_5)}$$

$$\text{graphic kurtosis } (k_g) = \frac{\phi_{95} - \phi_5}{2.44 (\phi_{75} - \phi_{25})}$$

Note: variables listed as " ϕ_{16} " (for example) means "Phi size at 16%, cumulative percent coarser", derived from log probability/phi size plots.

statistical parameters by graphical means. Median is not listed. This is simply ϕ size at 50% on the latter graph. Grain sizes of less than 4.00 ϕ (.0625 mm) to 10 ϕ (.00098 mm) were determined, if necessary, using a settling tube and the pipette method. Phi sizes of 11 and smaller are affected by Brownian motion and were not considered in the analysis. The pipette or settling tube analysis is based on Stokes Law. The relationship is exhibited in the formula:

$$T = \frac{D}{1500 \cdot A \cdot d^2}$$

Where T is the time (minutes), D is depth of withdrawal (cm), A is a value of water viscosity corrected for temperature, d is the particle diameter (mm), and 1500 is a constant. Previous to pipette analyses, the samples were disaggregated chemically by adding an aliquot of sodium-hexametaphosphate (NaPO_3)₆. Cumulative percent coarser was then calculated using the formula:

$$\text{Cumulative \% coarser} = \frac{100 (S + F - P)}{S + F}$$

Where S is the weight of the sieved sample, F is the weight of the 40 pipette withdrawal, and P is the weight of the additional withdrawals for the 4.5, 5, 5.5, 6, 7, 8, 9, and 10 phi sizes.

Each fraction of sediment was studied under a binocular microscope to determine the percentage of aggregates. All samples were subjected to physical disaggregation using wood and rubber implements twice before sieving. However, if the sample was determined to have more than 25% aggregates during weighing, the sample was subjected to disaggregation again with a subsequent resieving.

Other split fractions were used in geochemical studies. Portions of all samples were subject to analysis to determine total CO₃, total organic carbon, pH, conductivity, mineralogy, angularity, sphericity, and color. Total CO₃ was determined using the pressure calcimeter method (Allison and Moodie 1965:1392-1396). Total organic carbon was determined using the Walkley-Black method (Allison 1965:1372-1376).

Measurements of pH and conductivity were determined using test meters. For preparation, the samples were immersed in 450 ml of deionized water and agitated for 30 seconds; turbidity was allowed to settle before the readings were made.

Mineralogy was determined using a petrographic microscope. Samples for study were withdrawn from the 3.750 (.074 mm) sieve after weighing. Slides were prepared with refractive oils. Initially, 100 grains were counted and percentages of minerals tallied. Subsequently, the entirety of the prepared sample was scanned for trace minerals.

Color, angularity (or roundness), and sphericity were determined for each sample as well. Munsell Soil Color Charts were used for color. Angularity/sphericity were determined using Powers' (1982) comparison chart incorporating Folk's (1955) median rho values for use in statistical studies.

A pit structure (Feature 16) discovered at the site was subject to a special sampling technique. It was sampled in 1 cm levels from a point above the defined floor to a point below (Figure 1) it for defining cultural modifications to the deposits. Logically, increased activity in a confined space would have some determinable modification in detailed analysis. The normal train of analyses were run on the samples, and they were graphed independently to determine attributes produced by cultural use.

RESULTS AND INTERPRETATIONS

Sedimentology and Stratigraphy

As noted, the deposits on 48SW5057 are eolian in origin and are, by definition, a shadow. Expectedly, the shadow would have started aggradation much earlier than is suggested by the reported radiocarbon results and observed depth of the natural deposits. Other shadow aggradations began as much as 9000 to 10,000 years B.P. (Hoefer 1987; Miller and Bower 1986; Miller and James 1987). The source material is from the Tipton member of the Green River Formation (Middle Eocene).

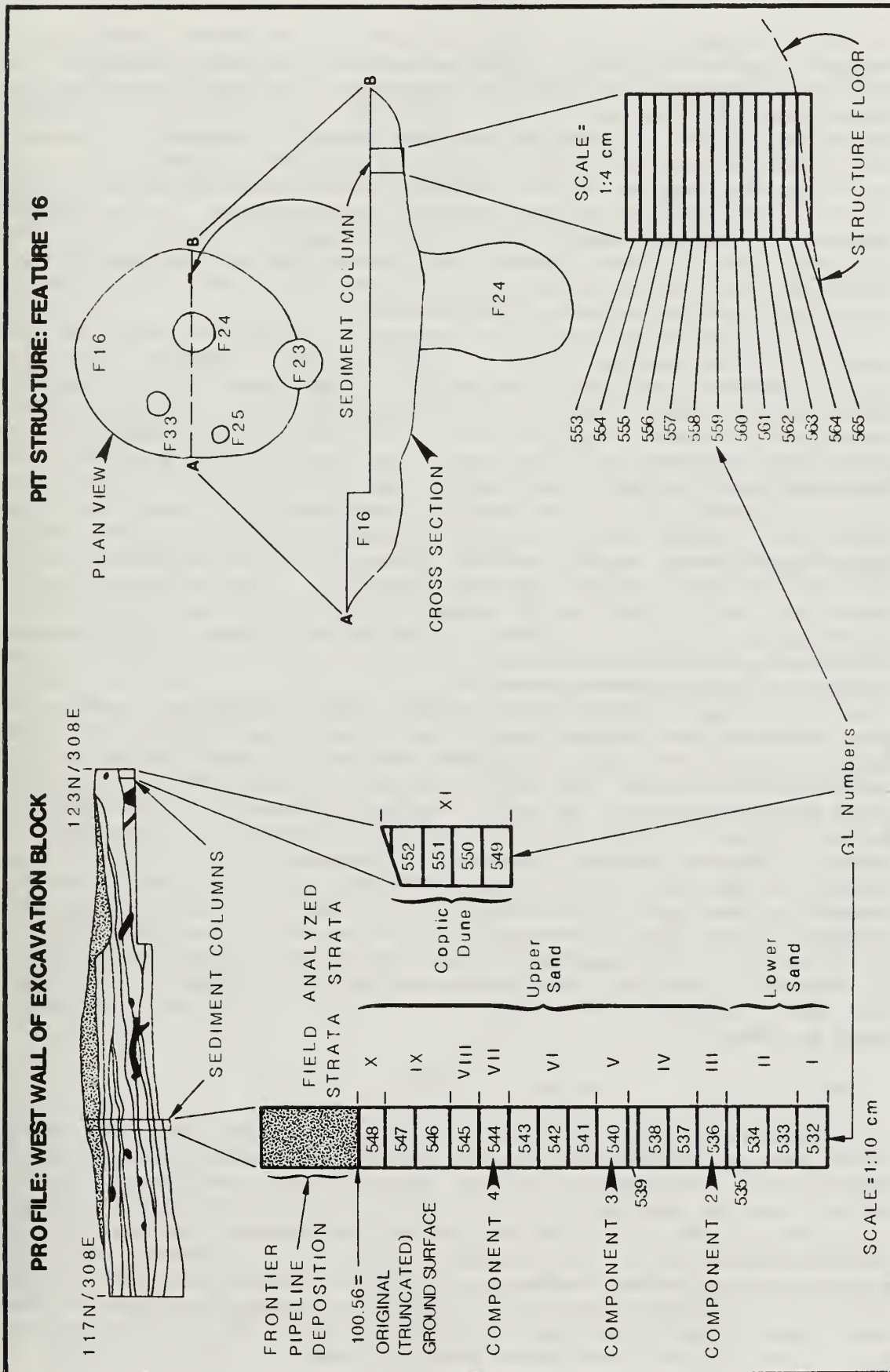


Figure 1. Illustration of the locations of all sediment columns showing the field strata and corresponding analyzed strata, with GL Numbers specified for samples.

The site is located in a late Pleistocene drainage dissection (a headward erosional feature). Increased pluvial conditions indicative of the Late Pleistocene produced the feature in which the flow gradient is concave up; thus far there is no evidence of a subsequent climatic period being able to accomplish the same degree of erosion. Subsequent depositional events were eolian, producing a convex up geometry.

When the samples of the sediment column were withdrawn, field workers identified ten strata numbered from the lowest to the highest beneath the Frontier Pipeline disturbance (Figure 1). Each stratum was numbered with a roman numeral and identified by certain visual characters which were commonly color and charcoal content with reference to particle size and secondary modifications.

Nine strata were identified in two stratigraphic zones at the location of the sample column. A tenth stratum (Stratum I) is the bedrock, composed of the Tipton member of the Green River Formation. Above Stratum I, the lower zone is by proper definition a poorly sorted, symmetrically skewed, mesokurtic silty fine sand; this is Stratum II of the field designations. The upper zone is a fine sand that is moderately well sorted, fine skewed, and leptokurtic; this comprises Strata III through X of the field designations. The lower and upper units are separated by a marked disconformity. Other minor disconformities are possibly present above this major disconformity, but they are not well defined sedimentologically. Three illuvial/eluvial zones are also evident and in association with the cultural horizons (Strata III, V, and VII). These are denoted by a three to five percent increase in authigenic clays and silts not found in unmodified eolian deposits of the same source material.

In the upper sand, three illuvial/eluvial developments were noted that indicate weak pluvial conditions in post-Neoglacial times. The lowest development persists through Stratum III and roughly to the middle of Stratum IV. The development has also had some effect in the upper part of Stratum II as well. Cultural Component 2 is Stratum III. As portrayed, Cultural Component 2 is an occupation in a large pluvial event. Likewise, Cultural Component 3 (Stratum V) is contained in a larger pluvial event, which includes portions of field Strata IV and VI. Similarly, Component 4 (Stratum VII) belongs to a larger event that contains all of field Strata VII and VIII as well as adjacent portions of VI and IX. To reiterate an earlier statement, all these units (i.e., III through X) are in a homogenous sand (with the exception of a single pond marl, sample GL 542). Tabulated results of the analysis can be found in Table 3.

Climate

Various lines of evidence, including palynology and radiocarbon aging and sedimentological interpretations, are important to paleoclimatology. The former two lines pertain more to biological activity of one sort or another while the latter is purely physical. Although sediments are in minor ways modified by the biomass present, they are largely regulated by the physical controls of climate (available moisture, temperature, wind, etc.), the physical parameters of the material being acted upon, and the conditions under which these actions take place. The system can be called binary in that for any deposit there are only two conditions that are notable: (a) the deposit is

aggrading, or (b) the deposit is not aggrading or eroding. For these two conditions, specific environmental conditions must be met. Admittedly, the interrelations are somewhat complex; but, nonetheless, the boundary is very thin when all conditions are taken into account.

At site 48SW5057, the boundary conditions for the various deposits were crossed several times. As with other sites, when the time difference was great, the sedimentological differences are great; when time was short, the sedimentological differences are small.

Two major strata were obvious in laboratory analysis, and these were previously identified as the lower sand (Stratum II) and the upper sand (Strata III through X). The lower sand, based on analogy to other sites, had an eluvial development usually representative of Neoglacial (ca. 3500-5500) or older developments. Cultural Component 1 lies on its upper contact, with radiocarbon ages of 1870 and 1840 B.P. A major disconformity is noted within these deposits which may represent the drought commonly noted between ca. 3500 to almost 2500 B.P. Above this disconformity is the upper sand.

The upper sand contained three cultural components, or occupations, each associated with one of these minor illuvial/eluvial developments; the lower two of these have been dated by radiocarbon means. These three illuvial/eluvial developments represent minor pulses of increased pluvial conditions. With comparison to the deposits in the lower sand, however, these pulses were not nearly as wet as those already identified as Neoglacial or older. These pulses date to ca. 1500 B.P., ca. 1250-1300 B.P., and at ca. 1900 B.P. Pulses with this frequency and interval have been noted from other sites in southwest Wyoming including 48CR4114 (Bower et al. 1986), 48LN1468 (Miller 1987b), 48SW5215 (Miller 1987a), and 48SW5377 (Miller 1986a), to mention a few. The pulses appear in total five times in a general period called the late Medithermal (as opposed to two previous periods in the Medithermal between ca. 3200-2000 B.P.). These periods occur, with consideration of altitude, latitude, and physiographic location at ca. 1900-1800 B.P., 1600-1500 B.P., 1350-1200 B.P., 1100-900 B.P., and ca. 500 B.P. The last of these intervals is suspected of being present but lacks the data base supporting the other four. As opposed to the earlier periods of the Medithermal, the latter period is ameliorating, representing a cross of the previous two. The early period (ca. 3200-2500) displays predominant droughts while the middle period (ca. 2500-2200) is considerably wetter. The late period is represented by widely fluctuating conditions.

The data as presented can be interpreted in two ways although with two different approaches. The first approach can be called a paleontological one which assumes a species response to varying climatic conditions. In this interpretation, a particular importance is assigned to the association of the cultural occupations with the eluvial/illuvial developments. A conclusion of this approach is an explanation of species response to the proposed climate alterations. The second approach is purely stratigraphic, explaining the absence of cultural occupations in intervening periods with erosion. This, in part, explains the state of Cultural Component 1. The paleontological approach, however, best explains all the evidence and is logically based on the needs of a species, in this case, the human species.

Table 3. Results of analysis of columns drawn from Site 48SW5057.

GL No.	ASS No.	cm BS*	Munsell		Ang.	Spher.	Total P ₃ (KPa)	Cond. T _{unhos} (cm)	pH.	Mean	Median	Mode	Sorting	Skewness	Kurtosis	org. C	% Silt/Clay
			Wet	Dry													
Provenience: 118.90-119.0N/308E																	
548	847	0-5	10YR4/4	10YR5/4	0.5	4.5	0.0	30.7	7.83	2.55	2.55	2.75	.7765	.0245	1.0861	.268	4.595
547	846	5-10	10YR4/4	10YR5/4	2.5	4.5	.6	6.7	8.02	2.48	2.45	2.75	.7894	.1219	1.3983	.790	3.0608
546	845	10-16	7.5YR4/4	7.5YR6/4	3.5	2.5	.20	18.6	8.6	2.72	2.70	2.75	.701	.060	1.04	.313	4.5969
545	844	16-21	7.5YR5/4	7.5YR6/4	3.5	-2.5	.30	22.5	8.65	2.77	2.75	2.75	.686	.062	1.11	.230	5.4494
544	843	21-26	7.5YR4/4	7.5YR5/4	3.5	2.5	.40	20.7	8.6	2.57	2.7	2.5	.69	.08	.98	.217	5.1226
543	842	26-31	7.5YR5/4	7.5YR6/4	3.5	2.5	1.7	18.1	8.63	2.6	2.6	2.75	.65	.02	1.05	.151	3.4606
542	841	31-36	7.5YR5/4	7.5YR6/4	3.5	4.5	.5	32.2	8.81	2.97	3.1	3.25	.82	.07	1.04	.383	12.1196
541	840	36-41	7.5YR5/4	7.5YR6/4	2.5	3.5	.7	17.5	8.75	2.53	2.5	2.75	.69	.17	1.23	.141	3.5065
540	839	41-46	7.5YR5/4	7.5YR6/4	2.5	5	1.7	23.7	8.9	2.6	2.7	2.75	.78	.13	1.11	.167	6.8019
539	838	46-48	7.5YR5/4	7.5YR6/4	3.5	2.5	1.3	24.7	8.48	2.77	2.7	2.75	.73	.13	1.02	.210	7.0228
538	837	48-53	7.5YR5/4	7.5YR6/4	3.5	2.5	2.0	22.1	8.48	2.63	2.7	2.75	.71	-.03	.98	.197	4.4451
537	836	53-58	7.5YR5/4	7.5YR6/4	2.5	2.5	1.5	22.7	8.55	2.57	2.6	2.75	.73	-.02	1.14	.163	3.2067
536	835	58-63	7.5YR5/4	7.5YR6/4	2.5	4.5	3.9	31.0	8.85	2.83	2.8	2.75	.77	.07	1.07	.706	7.401
535	834	63-65	7.5YR5/4	7.5YR6/4	3.5	2.5	7.2	31.4	8.85	2.93	2.9	2.75	.83	.24	.85	.775	12.5061
534	833	65-70	7.5YR5/4	7.5YR6/4	2.5	2.5	15.7	38.7	8.8	3.08	3.1	3.25	.972	-.013	.971	.354	17.8641
533	832	70-75	7.5YR5/4	7.5YR6/4	3.5	2.5	20.9	40.5	8.62	3.2	3.2	4.0	1.23	-.054	1.1	.478	22.5154
532	831	75-80	7.5YR5/4	7.5YR6/4	2.5	2.5	19.1	62.5	8.71	2.58	3.0	4.0	1.88	-.3069	1.127	.507	23.0377
Provenience: 122.90-123.0N/308.0N																	
552	869	23-28	10YR4/4	10YR5/4	2.5	2.5	7.5	35.1	8.78	3.03	3.0	3.25	.816	.077	1.07	.495	12.3458
551	868	28-33	10YR4/4	10YR5/4	2.5	4.5	3.6	30.0	8.71	2.98	2.9	2.75	.8617	.2143	.0979	.480	12.4857
550	867	33-38	10YR5/4	10YR6/4	3.5	2.5	5.3	37.2	8.83	2.76	2.7	2.75	.7439	.1684	1.840	.234	6.2925
549	866	38-43	10YR5/4	10YR6/4	3.5	2.5	4.1		8.82	2.73	2.6	2.75	.7717	.2959	1.1157	.204	6.3389
Provenience: 119.60N/323.35E (Feature 1c)																	
553	331.1	86-87	10YR4/4	10YR5/4	2.5	4.5	4.4	31.2	8.75	2.7833	2.7	2.75	.9405	.1655	1.0861	.48	8.3471
554	331.2	87-88	10YR4/4	10YR5/4	2.5	4.5	4.9	36.1	8.83	2.85	2.75	2.75	.8091	.1679	1.1066	.675	8.4207
555	331.3	88-89	10YR4/4	10YR5/4	2.5	4.5	4.8	28.9	8.79	2.8	2.7	2.75	.8167	.1756	1.0734	.387	8.135
556	331.4	89-90	10YR4/4	10YR6/4	2.5	7.5	6.4	31.2	8.67	2.8533	2.8	2.75	.8519	.1144	1.1855	.591	9.3785
557	331.5	90-91	10YR4/4	10YR5/4	2.5	4.5	6.0	32.1	8.67	2.6667	2.6	2.75	1.0076	-.1679	1.1939	.471	9.603
558	331.6	91-92	10YR4/4	10YR5/4	2.5	4.5	6.2	35.6	8.7	2.833	2.8	2.75	.8443	.1547	1.0619	.696	10.4419
559	331.7	92-93	10YR3/4	10YR5/4	2.5	2.5	4.1	33.9	8.8	2.85	2.75	2.75	.8845	.1937	1.0991	.546	10.8377
560	331.8	93-94	10YR3/4	10YR5/4	3.5	2.5	5.1	39.0	8.7	2.9	2.8	2.75	1.5667	.0781	1.0246	.789	16.0707
561	331.9	94-95	10YR2/2	10YR4/4	3.5	4.5	5.4	44.7	8.75	2.5833	2.8	3.25	.8746	.2127	1.087	1.08	11.7537
562	331.10	95-96	10YR3/2	10YR4/3	2.5	4.5	6.5	43.7	8.73	2.833	2.8	2.75	.8466	.177	.9672	1.07	10.9899
563	331.11	96-97	10YR3/2	10YR5/4	3.5	2.5	5.4	39.8	8.81	2.8833	2.85	2.75	.8671	.1051	1.1905	.875	8.8465
564	331.12	97-98	10YR3/4	10YR5/4	3.5	4.5	4.3	33.1	8.89	2.9167	2.85	2.75	.8417	.2636	1.0746	.861	10.9848
565	331.13	98-99	10YR4/4	10YR5/4	3.5	4.5	7.6	42.7	8.9	2.833	2.8	2.75	.8297	.1713	.98	.519	9.5077

*below surface

Key: Ang = Angularity

Spher = Sphericity

KPa = Kilopascals of pressure in calcimeter, not weight

Special Analyses

In addition to the single column (119.ON, 308.OE; GL Nos. 532-548) obtained for climatic interpretations, two accessory columns were procured: one was at 123.ON/308.OE (GL No. 549-552) on a deposit that was obviously different visually due to increased CaCO_3 content; the other was through the floor of Feature 16 (a pit structure; GL No. 553-565) to define possible cultural modification of the floor.

A determination was made from GL 549-542 that this deposit was a lower component of the upper sand. The deposit was likely a coptic dune or mobile sheet with a minor marl near its upper surface. Carbonates present appear to be from vadose evaporation and are carbonate concentrations due to the evaporation of groundwater as the vadose limit approached the surface at that time.

The second column (see Figure 1), procured from Feature 16, was designed to sample possible cultural modification of pit structure floors to delimit analytically what modifications may be present. GL No. 564 is a sample drawn from the floor of the structure. The following discussion will concern the relation of this sample to others in the column. The factors of angularity and sphericity should be important in such a discussion; but as these values are not quantitative, (i.e., they are estimates) they are precluded from consideration. Sample interval was 1 cm.

The following facts are presented pertaining to the suspected floor: (a) the mean and median size of GL 564 are smaller than those for any other sample in the column (and indeed the site); (b) sorting is slightly worse than other deposits, except disconformities (this is not considered significant); (c) the deposit is more positively finely skewed than any other deposit on the site (except for bedrock, which is a lacustrine deposit); (d) although technically mesokurtic (after Folk 1974), sample GL 564 tends toward platykurtosis compared to most samples from the site. These facts were partially present in analysis of a pit structure floor at another site (48FR1602).

Increased activity on a surface restricted in areal extent perhaps by some containment (i.e., a superstructure) necessarily increases the modification of sediment in that area. The expected result would be crushing, which would produce smaller mean and median sizes. The increase of smaller particles increases the positive skewness. Crushing would also modify the natural distribution, crushing large particles but not necessarily the smallest particles (which would be protected in the interstices between the larger ones); however, most of the crushing effect would be felt by the most common particle size (the mode) as two few particles larger than that could not protect these sizes. Therefore, the population distribution should become more platykurtic.

Further analysis will be carried out to determine if these relationships are true for all such structures, or at least a majority. As noted, the only two such analyses carried out (on this site and on 48FR1602) yielded similar results.

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The Buffalo Hump Site : late
prehistoric occupation in

